

Teaching Methods for Pupils with Low Mathematical Skills in Primary Schools

Case Study of Teaching Mathematics in Primary Schools, Tanzania

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Abstract

This study investigated the teaching methods used by the teachers in teaching pupils with low mathematical skills in Tanzania. The aim of this study was to introduce an effective intervention for enhancing pupils' achievement levels in mathematics. The problem of low mathematical skills is caused by many reasons such as unsuitable teaching and learning environment, few teaching methods, negative attitude of pupils and parents towards mathematics, shortage of teaching and learning materials, negative interaction between teachers and pupils to mention few. Studies show that, pupils who experience learning difficulties may not be intellectually impaired; rather their learning problems may be the result of an inadequate design of instruction in curricular materials (Mathematics learning difficulties in primary education, 2008).

This study used a qualitative approach which adopts a case study design. Also, the study adopted purposive sampling whereby four primary schools were selected and four teachers who teach mathematics in grade three from each school were the sample. Data were collected through observation and interview in which unstructured interview with open –ended questions were asked. The data obtained was analyzed following data through data reduction technique and presented through themes, sub-themes and short statements (Miles & Huberman, 1994). The analysis and interpretation of results was guided by the perspectives derived from three theories which are Vygotsky Cognitive Development Theory, Bronfenbrenner Ecological System Theory, Constructivism Theory and other studies from different literatures.

The study shows two major findings: First, There were a large number of pupils in the classroom which caused teachers to fail to use different teaching methods. Second, There was a shortage of teaching and learning materials especially textbooks for both teachers and pupils. Two main recommendations of the findings are presented. Firstly, the findings point to the need to reduce the class size so as to enable teachers to accommodate every pupil in the mathematical classrooms. Secondly, there is a need to dedicate more teaching and learning text books for both teachers and pupils.

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Tulia Deo Bamira Michael

Dedication

I dedicate this thesis to my children and my husband

Love God; obey parents and study hard you will leave happy life.

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List of Abbreviations

CRM Curriculum Relational Modal

CHAT Cultural Historical Activity Theory

DEO District Education Officer

EFA Education For All

HT Head Teacher

IQ Intelligence Quotient

LMS Low Mathematical Skills

MD Mathematical Difficulties

MAT Mathematical Association of Tanzania

MoEVT Ministry of Education and Vocational Training

REO Regional Education Officer

TEDP Teacher Education Development Plan

TEMP Teacher Education Master Plan

UNESCO United Nations Educational Scientific and Cultural Organizations

UDHR Universal Declaration of Human Rights

UN United Nations

ZPD Zonal of Proximal Development

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Table 1: Number of pupils in the classes

Table 2: Teaching experience in mathematics

Table 3: Different types of teaching and learning materials

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1 Introduction

1.1 Introduction and background

This chapter presents the background information and the problem of the study focusing on the teaching methods which teachers use for pupils with low mathematical skills. It is a case study in which four teachers each from four primary schools who teach mathematics in grade three were investigated. My personal goals and experiences as a teacher and an education administrator at the national level is part of my motivation to explore teaching methods used to help children with low mathematical skills. The touchstone of your own experience may be a more valuable indicator of a potentially successful research endeavor (Maxwell, 2005).

Tanzania is one of the countries which lag behind in performance in mathematics as a subject from primary level up to higher learning institutions. Despite the fact that the government effort of putting a budget for capacity building for mathematics teachers, purchasing teaching resources, different books other teaching materials and equipment, the number of learners with low mathematical skills in primary schools is believed to be increasing day after day. There are twelve components of mathematical skills, these are: problem solving, communicating mathematical ideas, mathematical reasoning, apply mathematics to every day situation, alertness to the reasonableness of results, estimation, appropriate computational skills, algebraic thinking, measurement, geometry, statistics and probability (Chinn, 2004). Pupils with low mathematical skills have deficit of some of the skills mentioned above by the (ibid). Also, Reisman (1972) argues that pupils with low mathematical skills are those underachieving in mathematics subject. Pupils in primary schools normally perform better in other subjects except in mathematics (Kitta, 2004). Hence, different Tanzanian scholars have come to pinpoint mathematics as a national problem that leads failure for many pupils (ibid). This study considers the problem of low mathematical skills within an inclusive education paradigm, investigating the teaching methods used by the teachers in the primary schools to meet the needs of pupils with low mathematical skills in Tanzania.

1.2 The practical field and personal experience

From my personal experiences, in Tanzania many children learn mathematics from home before they go to school; this is also supported by Hughes (1986) who argues that children learn numbers before they start school. Parents and siblings teach young children simple arithmetic according to the things they have within their environment. Children are taught to count animals and the sacks of crops and to count the money, especially coins. When they go to school they have a little knowledge of additions and subtractions. From grade one up to grade two most primary pupils in Tanzania normally perform well in mathematics subject. When they start grade three, things start to change slowly and the number of pupils with low mathematical skills emerge in this grade and following grades.

Moreover, a seminar organized for mathematics teachers by The Mathematical Association of Tanzania (MAT) in 2010 identified the major causes of low mathematical skills among pupils as emanating from pupils, teachers and the community including parents, while others attributed the problem to lazy pupils (Why are students performing poorly in mathematics, 2010). This problem of low mathematical skills among many primary pupils is what motivated the investigator to investigate the cause of this existing problem in Tanzania. From this experience it might be possible that most teachers change methods and strategies when they start teaching mathematics at grade three. This could be the result of changes in the curriculum in which children are exposed to place values of numbers increasing from hundreds to thousands.

1.3 Educational system in Tanzania

The current Tanzanian educational system is structured to include formal and non- formal education and training. The formal education and training covers 2 years of pre-primary, and 7 years of primary education. Then 6 years of secondary education that consists of 4 years of ordinary level and 2 years of advanced secondary school education, certificate and diploma in teacher education, and other vocational training programs. The next level is tertiary education that consists of at least 3 years of schooling and above (2-7-4-2-3+).

1.4 Inclusive education in Tanzania

The concept of inclusive education has been evolving over a period of time. Initially, inclusive education mainly focused on mainstreaming learners with special needs into normal classroom. In the contemporary literature, however, the term inclusive education has been defined in a broader perspective, in which the notion of special needs education has been extended to incorporate learners who are contextually disadvantaged, interpersonally challenged and individually disabled (Beyers & Hay, 2007). Many writers have defined inclusive education as a type of education that recognizes and appropriately supports students with a wide range of abilities and disabilities in the general education classroom (Salend, 2001). Therefore, inclusive education advocates for the type of education that integrates children with special needs, both gifted and talented, and those with learning disabilities with their peers within the mainstream classrooms (Lloyd, 2008). The concept of inclusive education is based on philosophical position that all learners, regardless of the type and level of disabilities and different background should be educated in the same general education classroom as their same age peers (Crawford, 1994).

In enforcing rights to education, Tanzania has signed the Universal Declaration of Human Rights (1948) that also emphasis rights to education to all citizens and basic education is seen as a basic right and compulsory for all. The Jomtien Declaration emphasizes that *“Every child has a right to education, which considers the children unique abilities and learning needs”* (UNESCO, 1990). Later on the Dakar framework of acting (UNESCO, 2000) did put more emphasis on providing education to all children.

One of strategies to implement the international declaration on rights to education is that; Tanzania has formulated the Tanzania Education Vision 2025 which demands the development Tanzania it's their fullest potential. To realise this vision, the education of teachers has been given the highest priority and the Teacher Education Master Plan (TEMP) and the Teacher Education Development Plan (TEDP) have been formulated. The TEMP envisages developing teachers so that they are competent and able to meet the diverse learner needs. This study considers low mathematical skills within an inclusive education paradigm. It also investigates the teaching methods which teachers use in the primary schools for pupils with low mathematical skills in Tanzania.

1.5 Importance of mathematics

Mathematics can be broadly interpreted as something a person does when solving problems in real life situations. It includes the role of intuition, fluidity of mathematical conceptualization, open-endedness, and nature of proof, use of logic and questioning within mathematical contexts (Underhill et al., 1980). We use mathematics in many areas of our lives and we can work on problems within mathematics that use mathematics as a tool, like problems in science and geography (The Math's Teacher's Handbook, 2007). The importance of mathematical skills includes among others, is to enable an individual to cope with their daily life (ibid).

Most of the mathematics used in everyday life is embedded in practical problems as Hughes (1986) states that:

Mathematics is only “useful” to the extent to which it can be applied to a particular situation, and it is the ability to apply Mathematics to a variety of situations to which we give the name “problem solving”. However, the solution of mathematical problem cannot begin until the problem has been translated into the appropriate mathematical terms. This first and essential step presents very great difficulties to many pupils – a fact which is often too little appreciated (p.3).

Also, basic skills of mathematics help an individual to be an independent person who can take care of himself or herself. In line with this, Naggar-Smith (2008) lists some important basic skills of mathematics in our daily life. These include: to pay for purchase and to give change, to weigh and to measure, to estimate and approximate and to understand straight forward timetables. In this sense, if one fails to grasp the simple basics of mathematics, that person may face difficulties in the above realities (ibid).

1.6 Research problem

The Tanzanian government has taken different Initiatives towards mathematics subject through workshops, seminars, buying more mathematical text books and teaching aids to provide teachers with methods and other resources (Kita, 1994). However, despite these efforts, students' poor performance and low mathematical skills has long been a subject of discussion among parents, teachers, educators, political leaders and students, themselves (ibid). In line with Kita, Poyo (2012) argue that there is a problem of low mathematical skills among the primary school pupils. Poyo continues by saying that, this is caused by many reasons such as; unqualified teachers, few teaching methods, unsuitable of teaching and

learning environment, shortage of text books and teaching aids, and low awareness of pupils towards mathematics (ibid). This study investigated the teaching methods which teachers use in teaching pupils with low mathematical skills in Tanzania with a focus on Arusha District Council.

1.7 Justification of the study

The goal of doing this study is to investigate the teaching methods used by teachers when instructing pupils who have mathematical difficulties in Tanzania with the aim of finding proper intervention strategies to increase the number of pupils who will have high achievement in mathematics. The specific objectives of this study are:

- i. To explore the teaching methods which teachers use in teaching mathematics to pupils with low mathematical skills
- ii. To explore the kind of instructions which teachers use in teaching mathematics to pupils with low mathematical skills
- iii. To explore the kind of activities do teachers give the pupils with low mathematical skills.
- iv. To find out the kind of teaching materials do teachers use in teaching pupils with low mathematical skills.

1.8 Research questions

In order to focus on the phenomena of investigating teaching methods which teachers use when teaching the pupils with low mathematical skills, the following questions were investigated.

Main question

How are the teaching conditions and the use of teaching methods for teachers teaching mathematics to pupils with low mathematical skills in the inclusive classrooms?

Sub questions

- i. What kind of instructions do teachers use when teaching mathematics to pupils with low mathematical skills?
- ii. What kind of activities do teachers give to pupils with low mathematical skills?

- iii. What kind of teaching materials do teachers use in teaching pupils with low mathematical skills?

1.9 Limitation of the study

The main challenge of the study was a delay for starting investigation. It took two weeks to get permission from the authorities. In line with this, all primary school were closed for holiday for one month and the National census was conducted for one week.

1.10 Delimitation of the study

This study was delimited to four primary schools located in Arusha District Council Tanzania. The teaching methods for pupils with low mathematical skills in the grade three are the focus of the study. The study was planned to be finalized in six months though due to the delay of the permission obtained from education authorities, closure of the schools and the National census the study was done for three months.

1.11 Significance of the study

It is believed that the study will have the following significances:

- i. Gives insight to policy makers, curriculum developers and other educational stakeholders at various levels of educational administrations and teachers taking measures to overcome the existing problems of low mathematical skills for primary school pupils in Tanzania.
- ii. Adds to the knowledge we have about the current teaching methods in mathematics for Tanzanian primary schools.
- iii. Indicates strategies and intervention to explore and overcome the challenges in teaching pupils with low mathematical skills.
- iv. Can be used as a reference to other researchers who want to do their research in teaching methods for pupils with low mathematical skills.

1.12 Location and demographic information about Arusha District Council

1.12.1 Location, size and population

Arusha District Council is among the two councils that forms Arumeru. It occupies an area of 1,547.6 square kilometers. The council now is approximated to have a population of 355,892 of which 171, 511 are males and 184, 384 are females (The National census, 2002). In the East the council is bordered by Meru District Council, in the west the council is bordered by Monduli District Council, In the North is bordered by Longido District Council, in the South is bordered by Simanjiro District Council.

1.12.2 Norms and Customs

Most of indigenous in the Arusha District Council are Maasai by tradition. Their traditional food is a mixture of milk, maize and beans which known in tradition name as “*Roshoro*”. Their traditional dances mostly use drums to dance whereby men bring up shoulders when dancing and women shake their shoulders. Their houses are round in shapes in which there are no rooms.

1.12.3 Economy and activities

Agriculture and livestock production are major economic activities in Arusha District Council. The district has an arable land of 78, 350 hectares. A number of crops are grown both cash and food crops. Live stocks kept in the district include dairy cows, indigenous cattle, chicken, goats and sheep.

1.13 Organization of the study

The study has five chapters. The first chapter focuses on the introduction and background, statement of the problem, objective and implication of the study, boundaries and delimitation demarcation of the study. The second chapter comprises literature review related to the study and theories presentations. The third chapter presents the methodology of the study. The presentation, data analysis and discussion of the results/findings of the study are dealt with in chapter four. The fifth and last part deals with discussion, conclusion and recommendations.

2 LITERATURE REVIEW

As stated by the research questions, the study is focused on the teaching methods for primary school pupils with low mathematical skills in Tanzania. The purpose is to suggest intervention strategies that can help to reduce on the number of pupils with low mathematical skills and increase on the interest and love of mathematics as a subject in the primary school. Chapter two presents a review of the literature which includes some theoretical aspects and previous studies. The theoretical aspects which will be included in this chapter are: Vygotsky's Cognitive Development Theory (1978), Bronfenbrenner Ecological System Theory (1979), and Constructivism Theory (1930's).

2.1 Teaching and learning mathematics

Learning skills and remembering facts in mathematics are important but they are only means to an end (The Math's Teacher's Handbook, 2007). Facts and skills are not important in themselves; they are important when we need them to solve a problem. Students will remember facts and skills easily when they use them to solve real problems. As well as using mathematics to solve real –life problems, students should also be taught about the different parts of mathematics, and how they fit together (ibid). Mathematics can be taught using a step-by-step approach to a topic but it is important to show that many topics are linked (Allsopp et al., 2007). It is also important to show students that mathematics is done all over the world (De Lange, 1996; Ma, 1999). The goal of teaching mathematics is to help pupils become more independent and critical thinkers who understand the purpose of mathematics and the ways in which mathematics can be applied meaningfully in their daily life situation (Halai, 1998). Allsopp et al., (2007) mentions and discusses some ideas how the pupils can do mathematics in a good way. These ideas are problem solving, reasoning, connections, communication and representation.

The Constitution of Tanzania (1992) insists on ensuring that there are equal and adequate opportunities to all persons to acquire educational and vocational training at all levels of schools and other institutions of learning (Komba, 2009). However, the constitution declares that every person has the right to access education of his choice up to the highest level according to his virtues and ability. The most important consideration for teachers is to understand that children have various learning styles, interests and general learning

difficulties (Johnsen, 2001). Facilitation of mathematics to pupils in primary schools can be of great values for processes that include; understanding the numbers, acquiring the knowledge of counting and the concepts of adding, subtraction, multiplying and dividing whole numbers up to ten thousand without or with grouping (Allsopp et al., 2007).

2.2 Theory presentation

2.2.1 Vygotsky's Theory of Cognitive Development

Vygotsky proposed that adults promote children's cognitive development both by passing along the meanings that their culture assigns to objects and events and by assisting children with challenging tasks (Vygotsky, 1978; Vygotsky Learning theory, 2012). Social activities are often precursors to, and form the basis for, complex mental processes (Cole, 1996; Vygotsky Learning theory, 2012). Children initially use new skills in the course of interacting with adults or peers and slowly internalize these skills for their own, independent use (Vygotsky, 1978; Cole, 1996; Vygotsky Learning theory, 2012). Van Oers (1996); Reys et al., (1998); Skemp, (1989) supports the Vygotskian approach to teaching and learning process by stressing the importance of social interaction and discussion in learning. In line with this, Pound (1999) argued that social interactions help children to make connections between the separate bits of information they acquire through their own actions, observations and reflection. Often, children first experiment with adult tasks and ways of thinking within the context of their early play activities (Vygotsky, 1978; Cole, 1996).

His theory involved a child internalizing the sign systems of the culture in order to think and solve a problem without the assistance of others (ibid); (The cognitive theories of Piaget and Vygotsky, 2009). The first step in development is the acquisition of language and understanding that actions and sounds have meaning. Culture is transmitted through language; therefore, language and communication are important sign systems (Bruner, 1990; The cognitive theories of Piaget and Vygotsky, 2009). Another trait of language is private speech. Private or internal speech is significant in guiding actions and promoting learning in children and adults (Vygotsky, 1978); (ibid). The next stage of Vygotsky's cognitive development theory involves the zone of proximal development, which is the next level of development immediately above a person's present level (ibid). In other words a person is in the zone of

proximal development when they can accomplish a task with the assistance of another that they could not do alone. The final stage in his cognitive theory involves scaffolding, which allows for assistance to facilitate mastering a new concept. Scaffolding occurs within the zone of proximal development and helps the student become autonomous in their learning (Vygotsky, 1978; Rogoff, 2003; Bruner, 1990; The cognitive theories of Piaget and Vygotsky, 2009).

Vygotsky (1978) considered that the child's cognitive development is determined by two developmental levels: actual developmental level and the zone of proximal development. Actual developmental level represents an already completed developmental cycle which contains what the child is able to do alone. In other words we can say that it is the independent level of mastery or what s/he has already mastered and achieved alone. Vygotsky introduced the notion of Zonal of Proximal Development (ZPD) in the process of child learning and development of higher mental psychological function (ibid). Vygotsky (1978) argues that:

Every function in the child's cultural development appears twice. One is on the social level and later on the individual level. First between people (inter psychological) and then inside the child (intra psychological). This implies equal to voluntary attention, to logical memory and to the formation of concepts. All the higher functions originate as actual relationship between individuals (p.57).

Vygotsky emphasizes the relationship between humans and the social cultural context in which they act and interact in shared experiences (Crawford, 1996; The cognitive theories of Piaget and Vygotsky, 2009). According to Vygotsky (1978) the Zone of Proximal Development (ZDP) represents the distance or gap between the actual and potential level, between what an individual child is able to do alone and what s/he can achieve 'through problem solving under adult guidance or in collaboration with more experienced or capable peers or adult (Vygotsky, 1978; Rogoff, 2003).

Therefore, learning development is the result of interaction between the child and his/her environment (Vygotsky, 1978; Vygotskian perspective on cognitive development, 2002).

Learning activities that follow within a child's zone of proximal development have a high probability of success, whereas activities beyond the zone may result in a failure and frustration (Reys et al., 1998). The environment in school perspective represents teachers and peers in class and in play. As it may be seen from Vygotsky's theory, a prerequisite to teach

pupils mathematics is first to determine their actual levels. According to Vygotsky's theory of cognitive development, learning is a result of interaction between pupils and more capable peers (Vygotsky, 1978). With some guidance either directly or indirectly from an adult or peer, a child can master the knowledge, skills or strategy very easy (Westwood, 2004).

In connection with Vygotsky idea of Zonal of Proximal Development, guided participation is another idea established by Rogoff (2003). She also stated that through cooperation, pupils became their own teachers in the process of guided participation and shared understanding of activities. Also, Rogoff, (2003) argues that: "*guided participation provides perspective to help of focus on the varied ways that children learn as they participate in and are guided by the values and practice of cultural communities*"(p.283-284). In addition to guided participation, apprenticeship is another idea provided by Rogoff (ibid). Apprenticeship is the process of learning by involvement through observation (ibid).

In supporting Vygotsky idea, Bruner (1990) provides the notion of scaffolding as explained in section 2.5.6 linked to the Zone of Proximal Development. There are two ways in which caregivers scaffold or assist young children in learning a language (ibid). First, is by joint instruction of language and second is by gradually withdrawing their support as children gain independent mastery of language. From this perspective of scaffolding, a pupil with low mathematical skills, when given a complex task by the teacher and try to solve it and fail, a teacher must use any effort to assist or help this pupil so as to understand the task and accomplish it. In scaffolding the teacher or aide models the expected behavior and then guides the student through the early stage of understanding. The student understands increases as the teacher gradually withdraws aid (Kirk et al., 2011).

Furthermore, Social constructivism is a philosophy which emphasizes culture and context in understanding what occurs in society and constructing knowledge based on this understanding (McMahon, 1997; Social Constructivism- Emerging Perspectives on Learning, 2008). Also, Vygotsky emphasizes that the classroom interaction between students and teachers and creative collaboration help pupils to accomplish their work (Wells & Claxton, 2002). His work emphasizes three main themes. The first is the importance of culture, the second is the central role of language, and the third is what he termed the "zone of proximal growth or development (ZPD)" (Vygotsky, 1978; The Teaching and Learning of Competence Based

Mathematics, 2010). The Zone of Proximal Development emphasizes the construction of knowledge within a cooperative environment (Wells & Claxton, 2002).

2.2.2 Bronfenbrenner Ecological System Theory

A child's development is the result of interaction with environmental systems surrounding a child (Bronfenbrenner, 1979). Bronfenbrenner Ecological System Theory focuses on quality and context of the child's environment. The interaction between child and environment may cause the child's physical and cognitive structure to grow and mature. These surroundings may help or hinder a child's developmental continuation. No matter what degree of exceptionality, how the child will eventually adapt to life and how the environmental forces surrounding the child facilitate or inhibit his or her development (Kirk et al., 2011). That's why we need to spend so much time studying these outside forces which Bronfenbrenner refers to as the *ecology of the human development*. The life of the child is in no way without a link to the interaction within the web of what Bronfenbrenner refers as ecology of the human development. It is assumed that the interactive ecology can provide to a child a platform (family, peers, public, and schools) that may either perpetuate something constructive or confusing. Bronfenbrenner (1979) calls the interactive development the ecology of human development where he placed the child in an ecological perspective. He argues that:

The ecology of human development involves the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by relations between these settings and by the larger context in which the setting are embedded (p.21).

From this perspective of social ecological system theory, the success or failure of the pupil is mainly caused by environmental situations such as: changes in care giving in the family, social changes in the community, educational challenges, parent or adolescent siblings occupational challenges, poverty, social economic factors, legal system or crime problems and other environmental situations may affect the child's development and functioning.

In addition to that, Cole (1996) inserted the notion of context as that surround which surround a child. From Cole's concentric circle which represents the notion of context as that which surrounds, a child is at the center. The child is surrounded by; task, concept, lesson, teacher, classroom organization, principal, community organization, parents, school district and other

social cultural institutions (ibid). All these surroundings have an impact to the child either direct or indirect (Berk, 2000). Also, The Bronfernbrenner Ecological System Theory is supported by the Cultural Historical Activity Theory (CHAT) in which a child's cognitive, socio- emotional and physical development are influenced by social, economic, cultural historical, community level factors and the ecological context in which a child grow up (Wells & Claxton, 2002). CHAT shows that the social interactions of a child are surrounded in larger units of communities and cultures or multiple levels in which the child participate directly or indirectly (ibid).

Bronfernbrenner's division of interactive systems

In studying human development, one has to see within, beyond, and across how the several systems interact (The family from a child development perspective, 2012). Bronfernbrenner (1979) has developed a model that consists of the relationship between the person and four systems. He discusses the impact of interaction between the child and the environment explaining the four systems which can affect the child directly or indirectly. His four interlocking systems that shape individual development (The family from a child development perspective, 2012) are as follows: The micro-system, the meso-system, the exo-system and the macro-system. The four systemic categorization of Bronfernbrenner, as can be seen in the following paragraphs indicate different levels of interaction and influence from the general surrounding that a child encounters. See the following figure below is showing the Bronfenbrenner model interactive systems.

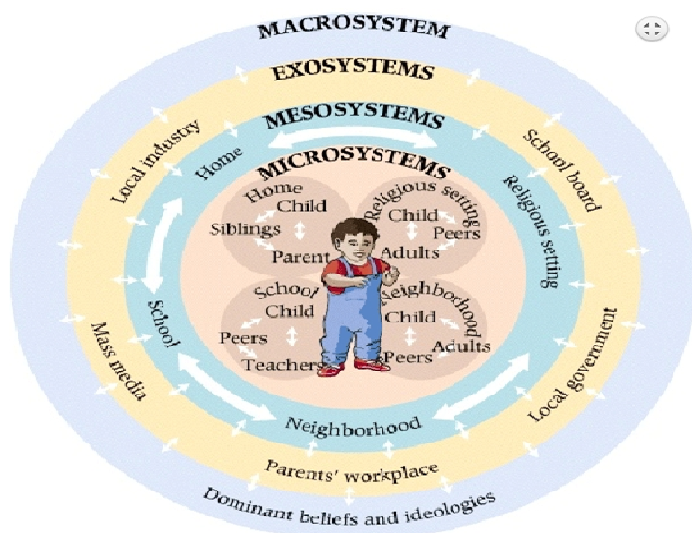


Figure 1. The Bronfenbrenner model interactive system. Adapted from Conceptual Framework –SMU, 2012.

The first system is the micro-system. Bronfenbrenner (1979) defines micro-system as: “*a pattern of activities, roles and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics*” (p.22). The micro-system includes family members, peers, school, neighbors, and caregivers within the environment. The micro-system is the level within which a child experiences immediate interactions with other people (The family from a child development perspective, 2012). At the beginning the micro-system is the home, involving the interaction with only one or two people in the family. Bronfenbrenner noted that as long as increased number s in a child’s microsystem mean more enduring reciprocal relationships, increasing the size of the system will enhance child development (ibid). Berk (2000) supports Bronfenbrenner by saying that the micro system comprehends the relationships and interactions a child has within his or her surroundings. In this system, the relationship has an impact both away from the child and toward the child (ibid). All these people have a great impact to the child. Bronfenbrenner calls these *bidirectional* influences and he shows how they occur within all levels (Bronfenbrenner (1979; Berk, 2000).

The second system is the meso-system. Bronfenbrenner (1979) defines Meso-system as; “*comprises the interrelations among two or more settings in which setting the developing person actively participates (such as, for a child, the relations among home, school, and neighborhood, peer group, for an adult, among family, work and social life*”(p.25). The meso-systems are the interrelationships among settings such as the home, a day care center, and the schools. The stronger and more diverse the links among setting, the more powerful and influence the resulting systems will be on the child’s development (The family from a child development perspective, 2012). There is a very big connection between the child’s teacher and her or his teacher parents, church and neighborhoods, government and court (Bronfenbrenner, 1979; Berk, 2000). The meso-system provides the connection between the structures of the child’s microsystem (ibid). For example, if a child moves from home to school finds new setting, this interconnection of extending new setting may take a number of additional forms. Also, teachers have a great chance to build a good interpersonal relationship with this child as well as positive interaction. In these interrelationships, the initiatives of the child, and parents’ involvement in linking the home and school, play roles in determining the quality of the child’s meso-system (ibid).

The third system is the exo-system. Bronfenbrenner (1979) defines an exo-system as, “*refers to one or more settings that do not involve the developing person as an active participant, but in which events occur that affect or are affected by what in the setting containing the developing person*” (p.25). The quality of interrelationships among setting is influenced by forces in which the child does not participate, but which have a direct bearing on parents and other adults who interact with the child (The family from a child development perspective, 2012). These may include the parental workplace, school boards, social service agencies and planning commission (Bronfenbrenner, 1979); (ibid). In this system a child is not directly involved but is affected positively or negatively in one way or another. For example, a parent’s work place may affect a child (Bronfenbrenner, 1979; Berk, 2000).

The fourth system is the macro-system. Bronfenbrenner (1979) defines macro-system as, “*refers to consistencies, in the form and content of lower order systems (micro-, meso- and exo-) that exist, or could exist, at the level of subculture as a whole, along with any belief system or ideology underlying such consistencies*” (p.26). At the macro-level and their interrelationships in shaping human development and they provide the broad ideological and organizational patterns within which the meso- and exo-systems reflect the ecology of human development (The family from a child development perspective, 2012). Examples of macro-system are culture, attitudes, morals, belief, and ideologies of the culture. Policies and educational bodies fall in this system (Bronfenbrenner, 1979).

In addition to that, macro-system has a big influence trough out the interaction of all other systems (Berk, 2000). Berk (2000) provides one example that, if the belief of the culture that parents should be solely responsible for raising their children, that culture is likely to provide resources to help parents. The parents’ ability or inability to carry out that responsibility toward their children within the context of the child’s microsystem is likewise affected (ibid).

2.2.3 Constructivism Theory

Consrtructivism theory was underlined by Piaget and supported by Montesory, Brunner and Vygotsky. Constructivism theory has become a mainstream theory in educational policy and practice scene as result national standard documents influencing the curriculum are affected (Westwood, 2003). In line with this, the realistic in mathematics education builds upon the principles of the constructivist learning theory (ibid). The current mathematics curriculum

assumes that the teaching and learning will be constructivist in approach (The Teaching and Learning of Competence Based Mathematics, 2010). The design of lessons has to be centered on the learner and oriented towards activities through which learners construct their knowledge as a result of the learning experience (ibid). This theory promotes active learning through doing and recognition of one's experience (Vygotsky, 1978). The constructivists believe that people must construct their knowledge on the basis of their experiences and that no other alternative exists (ibid). They build up knowledge and concepts (Glaserfeld, 1996). For example, Piaget inserted the notion of "schemata". Schemata consistently change as learners make sense of a wider range of experiences and as they link new information with prior knowledge (ibid). Knowledge might not only be connected to problem solving with concretes, but might be applied on semi-concrete, semi-symbolic and finally establish on the reflective level with the use of abstract symbols (Underhill, et al., (1980). Pictures and drawings can help to give meaning to the content of the mathematical task on the level that approaches the symbolic level (Hughes, 1986).

Constructivism is considered a driving force in mathematics education (The Teaching and Learning of Competence Based Mathematics, 2010). During the last two decades, pedagogical applications of constructivism have been endorsed extensively throughout the United States, the United Kingdom, Germany and Taiwan as a learning theory (ibid). It describes the knowledge as being an influx, where an individual internally constructs knowledge through social and cultural mediation (ibid). Mediation is the kind of communication between parents and child, teacher and pupil, pupil and pupil and also it can be a kind of teaching. Klein (2001) argues that, mediation represents an alternative to stimulation. It is achieved through the parents matching the child responses to object or incidents in the world. The concept of mediation includes affect regulation, sharing of the common focus, explaining and making plans for action. Also, in social cases, Bronfenbrenner (1979) supports that, a child is interacting and constructs knowledge within the society thus, is learning and develops his or her mental psychological functions. Bronfenbrenner (1979) states that:

Learning and development are facilitated by the participation of the developing person in progressively more complex patterns of reciprocal activity with someone with whom that person has developed a strong and enduring emotional attachment and when the balance of power gradually shifts in favour of the developing person (p.60).

The act of learning is considered a self-regulatory process where new information is accommodated in order to develop representations and models of reality (The Teaching and Learning of Competence Based Mathematics, 2010). Social activity and discourse play important roles for the understanding to occur (ibid). The classroom is viewed as a miniature society where a community of learners is engaged in activity, discourse and reflection (ibid). Learning takes place through interaction (Vgotsky, 1978). In order for a child to understand mathematics well he or she should interact with fellow peers (ibid). In this interaction a capable peer may help the child where he or she failed to solve mathematical problems (ibid).

General approach on constructivism theory

Glaserfeld (1996) maintains that the constructivism theory of knowledge has some valuable impacts for the teaching mathematics. The radical constructivists claim that knowledge is not passively received either through the senses or by a way of communication (Concept- Rich Mathematics Instruction, 2006). Knowledge is actively constructed by the person through cooperation with the environment. Pupils do not receive knowledge but must build it up themselves by an adaptive function of cognition. The constructivists believe that people must construct their knowledge on the basis of their experiences from day to day life or situations. They emphasize experiences from daily living situations and concrete actions in the process of building up knowledge and concepts Glaserfeld (1996). The constructivists claim that knowledge is constructed through active experiences, whether physical, mental or both (ibid). They build on Piaget's analyses which maintain that knowledge is actively built up by the organizing person through experiences (ibid).

Mathematics has been placed upon a pedestal as a realm of abstract. Intellectuals' people have suggested that mathematical knowledge was the result of the development of logical and children could not learn it until they were capable of logical thought (Piaget, 1973). Piaget in his theory constructivism theory outlines four developmental stages of the child in learning mathematics (ibid). Constructivism theory as underlined by its founder Jean Piaget and supported by Montessori, Bruner and Vygotsky has many contributions in teaching mathematics (Westwood, 2004). The constructivist view point on human learning suggests that true understanding cannot be directly passed from one individual to another but rather has to be constructed a new by each learner in his or her own mind as a result of experience and reflection (ibid).

General principles of constructivist learning

There are nine general principles of constructivist learning (The Teaching and Learning of Competence Based Mathematics, 2010). These principles are:

- i. Learning is an active process in which the learner uses sensory input and constructs meaning out of it.
- ii. People learn to learn as they learn. Learning consists both of constructing meaning and constructing systems of meaning.
- iii. The crucial action of constructing meaning is mental: it happens in the mind. Physical actions, hands-on experience may be necessary for learning, especially for children, but it is not sufficient; we need to provide activities which engage the mind as well as the hands.
- iv. Learning involves language: the language we use influences learning. Vygotsky argued that language and learning are inextricably intertwined.
- v. Learning is a social activity: our learning is intimately associated with our connection with other human beings, our teachers, our peers, our family as well as casual acquaintances.
- vi. Learning is contextual: we do not learn isolated facts and theories in some abstract ethereal land of the mind separate from the rest of our lives: we learn in relationship to what else we know, what we believe, our prejudices and our fears.
- vii. One needs knowledge to learn: it is not possible to assimilate new knowledge without having some structure developed from previous knowledge to build on. The more we know, the more we can learn.
- viii. Learning is not instantaneous. For significant learning we need to revisit ideas, ponder them try them out, play with them and use them.
- ix. Motivation is a key component in learning. Not only is it the case that motivation helps learning, it is essential for learning.

Implications to the teaching and learning process

Content implications

Galton et al., (1999) and Hunter (1994) have advised teachers to select methods of instructions that suit the types of learning involved in a lesson, as well as suiting the age, ability of the learner. A teaching method should be judged on its fitness for purpose

(Westwood, 2004). Thompson (1992) argues that, knowing mathematics may be stated as understanding of the specific areas of mathematics such as:

- i. Knowledge of history of mathematics
- ii. Knowledge on epistemology of mathematics
- iii. Knowledge of the philosophy of mathematics

The above basic knowledge helps teachers to relate concept construction, formalization and theoretical framing in the domain of mathematics and the relationship between mathematics and other socio-cultural field (The Teaching and Learning of Competence Based Mathematics, 2010).

Pedagogical Implications

In a constructivism classroom, teacher should act as facilitator, interpreter and mediator of meaning (Bay et al., 1999). Westwood (2004) suggests that, pedagogical implication include the following:

- i. Lessons preparations
- ii. Methods of teaching and learning
- iii. Material development
- iv. Assessment procedures

2.3 Mathematical difficulties

There are many children and adults who experience difficulties with mathematics (Dowker, 1998; Butterworth, 1999). A mathematical difficulty refers to children or adults who struggle or fail to cope with some of the aspects of arithmetic which are necessary for education or practical purposes (ibid). Studies have demonstrated that children with mathematical difficulties have particular impairments in understanding and processing numerical magnitude (Defective number module, 2011). However, little is known about the cognitive deficits that underlie their poor achievement in mathematics. Also, several cognitive studies have shown that children with difficulties in mathematics have structural and functional abnormalities in those areas of the brain that are involved in numerical magnitude processing (Mussolin et al., 2010 & Rotzer et al., 2008; Defective number module, 2011).

Pupils who are assumed to have mathematical difficulties are pupils with the lowest score in math (Ostad, 1997; 1998; 1999). Their main features are the inability to translate the problem into the appropriate mathematical terms (ibid). Also, Grauberg (1998) mentions those features as: problems in understanding symbols, lack of organizational skills, weakness in memory, the problem with relative concepts, weakness in auditory discrimination and difficulties in social interaction.

2.4 Causes of low mathematical skills

Many pupils may be labeled or identified as having low mathematical skills however; there are several aspects that may cause this problem for them (Reisman, 1972). These aspects can be caused by ; unfriendly teaching and learning environment, few teaching methods and strategies, poor teaching, shortage of teaching and learning materials, negative attitudes towards mathematics subject, gap in mathematical foundation, lack of readiness, emotional problems and so forth (ibid). Several studies show that low mathematical skills are caused by the situation and context, lack of accuracy in object counting accuracy and strategies, limited resources and limited formal schooling (Dowker, 2004). However, many researchers agree that, problems in other areas can be linked to language difficulties, reading difficulties, hearing loss, spatial difficulties and difficulties with aspects of memory (Chin, 2004). In line with this, cause of low mathematical skills is based on varying use of problem solving strategies, accuracy and speed processing (Ostad, 1999)

2.5 Pupils with low Mathematical skills

Pupils who have low mathematical skills are pupils who are underachieving in mathematics (Chinn, 2004; Reisman, 1972). There are three domains of math skills (called also cognitive dimension components, process competencies, or common competencies) – knowing, applying and problem solving (Männamaa, et al., 2012). The mathematical skills include two main aspects namely the knowledge of the number system and arithmetic fluency (ibid). Chin (2004) identifies some basic mathematical skills which these pupils may lack, these include: problem solving, communicating mathematical ideas, mathematical reasoning, applying mathematics to everyday situations, estimation, measurement, patterns, probability, geometry, appropriate computational skills, and algebraic thinking. In line with this, Donlan (1998) argues that pupils with low mathematical skills have low arithmetical ability whereby its

components include basic number knowledge, memory of arithmetical facts, the understanding of concepts and the ability to follow procedures. The number knowledge involves the ability to recognize numbers in different forms (numerals, number words, and concrete quantities) and to place them in order (ibid). Factual knowledge involves memory for different categories of facts (addition, multiplication, subtraction and division) (ibid). Conceptual understanding involves, understanding the properties of and relationships between arithmetical operations. Procedural knowledge involves memory for learned procedures (ibid). The low mathematical skills may correlate to impairments in mathematical difficulties (ibid).

2.5.1 Teaching strategies

Teaching strategies are defined as the procedure used to attain a goal (Ostad, 2001). However, as it has been mentioned, teaching cannot be the development of pupils. Thus, Vygotsky's theory of cognitive development clearly stressed the importance of learning through guided participation by the teacher and peers (Vygotsky, 1978; Rogoff, 2003). Johnsen (2001) presents four main aspects of teaching strategies first is teaching methods, second is classroom organizations, third is teaching materials, and fourth is peer support. More specifically, a more recently published study (Ostad 1999) shows that schools' support services had picked out about 10% of the children in some primary schools as needing remedial programs in mathematics (ibid). Ostad in his study in which has shown the typical children with mathematical difficulties continued use of primary backup strategies through the whole primary school (Ostad 1997a:1997b: 1999:2000). From the study, researchers investigated that most of teachers who teach mathematics use back up strategy when teaching mathematics (ibid).

The mathematically less able students used few strategies when solving elementary problems (Ostad 1997, a). There is certainly evidence from some studies that children with low mathematical skills often rely on counting strategies to the exclusion of both retrieval and derived fact strategies (Ostad, 1999). Despite mentioning features of pupils having difficulties in mathematics, there are some reasons which cause children to have difficult in learning mathematics or arithmetic. For example, Hughes (1986) argues about teaching of mathematics in primary school as one reason among other reasons for failure in mathematics subject. In addition to that, Reisman (1972) discusses some of the reasons which cause many

students fail mathematics subject. These include: gap in mathematical foundation, lack of readiness, emotional problems, deprived environment and poor teaching methods (ibid). Mittler (1974) pointed out some factors affecting arithmetic attainment in primary children. These factors include; intellectual factors, emotional factors, neurological factors, teachers attitude toward arithmetic and understanding of concepts, appropriate intervention in teaching, teaching aids, computational practice and absence from school (ibid). Referring to my specific context of this study, the main assumption of an increasing number of pupils with low mathematical skills in Tanzania might be due to the poor teaching methods as indicated by many researchers (Kitta, 2004).

2.5.2 Teaching methods

Teaching methods are comprised of principles which teachers use for instruction; they are about the different ways you can teach a topic in the classroom (Johnsen, 2001). These methods can be group discussion, lecture, demonstration, problem and puzzles, question and answers, oral and written testing, games or play, participatory and so forth (The Math's Teacher's Handbook, 2007). Also, Dalen (1982) describes three forms of instruction namely individual instruction, whole class teaching, and group teaching. The uses of variety in teaching methods for pupils with low mathematical skills motivates pupils, improve their learning skills, and enables them to learn quickly (The Math's Teacher's Handbook, 2007).

Teaching and learning mathematics poses a lot of challenges to teachers, stakeholders, government, parents and schools in education (Kafyulilo, 2011). Many countries are currently experiencing gradual drop in students' participation and performance in mathematics (Mwinshekke, 2003). Failure in this subject raises a debate on how teachers teach and how students learn (Kafyulilo, 2011). Some scholars debate the cause of low mathematical skills, however some of them have come to agree that although there are some reasons that may cause low mathematical skills to the most of primary pupils, but the main cause can be poor teaching methods or strategies (ibid). Some scholars argue that, there are probably many reasons for a student's failure in mathematics and most of them are likely to be based within the curriculum and the teaching methods rather than within the learner (Westwood, 2004). Pupils who exhibit learning difficulties may not be intellectually impaired; rather their learning problems may be the result of an inadequate design of instruction in curricular materials (Mathematics learning Difficulties in Primary Education, 2011).

In addition to that, inappropriate instruction that means instruction that does not differentiate between the types of learners in a group, which can cause mathematical difficulties for most of the learners (Chinn, 2004). This is supported by Donlan (1999) who argues that, mathematics is a domain in which the diversity of component skills is such that it allows dramatic individual differences to occur with some frequency. Failure to using teaching methods that make arithmetic meaningful is one of the causes of children lacking understanding in arithmetic (Chlute, 1984). This is supported by Milo (2003) who argues that, realistic instruction conforms to the learners' informal knowledge, and the role of the teacher should change from directing to guiding. Korthhagen et al., (2001) provides four pairs of principles which can be used in teaching mathematics and reduce failure of this subject. These principles are: To construct and to concretize, levels and models, reflection and production and the last principles are social context and interaction.

Another cause of low mathematical skills is the failure to use teaching aids, especially concrete objects. Dowker (2008) argues that, when considering various cultures, human body parts have been used as aids for counting in the development of some number system. It is now realized that pupils in all classes of the primary schools, and slow learners for all of their formal education, benefit if mathematical concepts are presented initially through the use of concrete materials (Duncan, 1978). Therefore, if the teacher decides that learning should be optimized through practical experiences, she or he must also arrange the classroom and use of concrete aids (ibid). Inline with this, some scholars see the failure as being born from teachers due to lack of important teaching competencies, while others see the failure as resulting from lack of students' motivation in mathematics (Kafyulilo, 2011). However, the problem of low mathematical skills can be caused by both teaching approaches and the way students learn (ibid).

2.5.3 Differentiation

Differentiation is the use of different teaching techniques and strategies to teach pupils concepts. UNESCO (2004) argues that, giving different learning tasks to pupils with different proximal learning possibilities, varying in study content, learning task, length of study content and length of time for solving a task are traditional ways of differentiating. Jonsen (2003) asserts differentiation as cited in UNESCO (1994) in the following way:

Curriculum education is the process of modifying or adapting the curriculum according to the different ability levels of the students in one class. Teachers can adapt or differentiate the curriculum by changing the content, and methods, for teaching and learning content (sometimes referred to as the process), and, methods of assessment (sometimes referred to as the product) (p.14).

The aim of differentiation is to meet the diversity of pupils' educational needs by applying a variety of instructions (Westwood 2004). Tomlinson (1995) stressed that differentiated instruction is not the individualized instruction, it is not losing control of student behavior and just another way to provide homogeneous grouping, it is not giving the same exercises or tasks to most pupils and different to pupils who showed difficulties. Hannell (2013) argues that, when teaching mathematics, teachers also need to consider different learning styles. Some children are slow reflective learners, while others like their learning to be fast. Some happily use trial and error but others work systematically through the problem until they get an answer. Some rely on intuitive thinking while others prefer concrete, practical ways of working things out (ibid).

However, teachers making the decisions about differentiation have in mind the diversity of pupils and they believe that effective instruction is based on pupils' active participation in decision making and problem solving (Tomlinson, 1995). Therefore, teachers should use different strategies and techniques for pupils with low mathematical skills so that they can learn the concepts in mathematics.

2.5.4 Classroom organization.

Classroom organization is one aspect of differentiation which focuses on the style of making pupils learn in different ways in the classroom. Sometime classroom organization enhances placement. In Cole's concentric circles (1996) which represent the notion of context that surrounds children's performance in a classroom lesson, classroom organization is among the levels. Wells and Claxton (2002) stress the importance of classroom organization in teaching and the learning process. These two authors noted that, "... *students who are at risk of educational failure, suggests that the social organization of the classroom is significantly implicated in the level of achievement*" (p.182). From this note of these authors, it is better to reduce the class size so as to improve pupils' achievement. Also, when the class size is reduced and organized in a good manner, it will be easy for teachers to accommodate all

pupils in the class in spite of their diversity such as learning abilities, disabilities, Social economic status, ethnicity, gender, sex e-t-c.

In line with this, Johnsen (2001) in her Curriculum Relational Model (CRM) as indicated in the annex I, elaborated on the connection of methods and classroom organization in teaching and the learning process. She argues that, teaching methods and organization have to be considered when planning group and classroom activities because pupils learn through different strategies, activities media and methods. Learning difficulties may branch from difficulties with learning strategies and methods, caused by biological, psychological or environmental factors or some combination of these factors (ibid).

2.5.5 Teaching materials

Teaching of mathematics includes helping pupils move from concrete to abstract thinking. Pupils need hands-on activities which include direct experience with materials and visual methods, representing materials and symbolic representation (Westwood 2004). From this perspective, the teachers' role is to make and use different teaching materials. Children must learn to link the new written form of representation with the concrete understanding of number which they already have when they start school (Hughes, 1986). Many studies show that mathematical operations might be performed with the help of visual imagery, which could be compared to some kind of mental board (Reuhkala, 2001). Mathematical ideas can often be represented in any form such as a physical representation, which are external representations, taking the form of language, written symbols, pictures, or physical objects (Ostad, 2001).

Mathematical concepts are introduced to the pupils in a practical context through the use of concrete materials (Duncan, 1978). The Piagetian stage of concrete operation explains that meaningful mathematics are mathematics about which the learner can think more including mental imagery, objects, drawings, and personal experience (Piaget, 1973). Underhill, et al., (1980) argue that the best instructional sequence is one that moves through a sequence of concrete, semi-concrete, and abstract learning experiences. Visual and spatial difficulties may affect a child's ability to use and understand some of the concrete materials used in teaching mathematics (Ostad, 1990; Dowker, 1998).

2.5.6 Scaffolding

The scaffolding concept is derived from Vygotsky's theory (1978) and was described for the first time by Bruner (1990). Scaffolding is the process by which an experienced person, or adult, provides help to a child who failed in performing the task by him or herself. Scaffolding and help in the Zone of Proximal Development are necessary and are passing the stage in human development (Wells & Claxton, 2002). The teacher, parents, or other adults in a child's world provide scaffolding to help them learn new information and develop more complex thinking abilities (Two important ideas about thinking from Vygotsky, 2011). A child who can't solve a mathematical problem might be able to do so with a little help or guidance from their teacher. Vygotsky introduced the idea of scaffolding through the notion of Zone of Proximal Development (ZPD). Vygotsky (1978) defined the ZPD as:

The distance between the child's actual developmental level as determined by independent problem solving and the higher level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p.75).

Scaffolding instruction as a teaching strategy is of high necessity in the mathematical classrooms so as to support pupils with number problems (Rogoff, 2003). Through interactions within the zone of proximal development children learn to use the intellectual tools of their community including: literacy, number systems, language, and tools for remembering and planning (ibid).

In addition, guided participation and apprenticeship are another ideas provided by Rogoff (1990; 2003) supporting Vygotsky's idea of ZPD. Rogoff (2003) elaborated on the idea of ZPD by saying that, children learn through their interactions with more experienced adult and peers, who support them in an activity beyond the zone in which they would be able to perform themselves without assistance (ibid). In cooperative activities, the pupils themselves often become teachers of each other in guided participation and shared understanding in routine problem solving activities (Rogoff 1990). Guided participation provides a perspective through which pupils can be helped in different ways as they learn, participate in activities, and are guided by their teachers, parents or peers (ibid).

2.5.7 Connectionism

Connectionism is the process of teaching by associating the home environment to mathematical concepts. As children grow, parents, caregivers, siblings and peers teach those simple arithmetic skills before they start school (Hughes, 1986; Hannell, 2013). Another example is given by Rogoff (2003) who said that in middle –class European and American families, children learn to participate in school-like conversation before they enter school. In order for meaningful mathematics to take place, connectionism and transformation should be applied in the teaching and learning processes. For example, In the Piagetian stage of concrete operations, the learner's mental activity is rooted in the here and now. Thinking is relative to the experiences and environments of the learner. For learners in the concrete operational stage, meaningful mathematics is mathematics about which the learner can think with mental imagery of objects, drawings and personal experiences (Carol et al., 1983). Connectionism helps students learn mathematics and appreciate the usefulness of mathematics. This is because students can see how it translates to contexts outside of mathematics even problem solving in everyday life (Allsopp et al., 2007).

Furthermore, Underhill et al., (1980) describes three types of meaningful mathematics learning experiences: concrete, semi-concrete and abstract. To enhance the meaningful learning of basic computational skills, these experiences aim at a duality of process relationships between real- world experiences and the symbolic system involved in computations (ibid). Teachers should teach mathematics by connecting home environment and pupil's experience. The National Council of Teachers of Mathematics (NCTM) (2000) states that:

The most important connection for early mathematics development is between the intuitive, informal mathematics that the learners have learned through their own experiences and the mathematics they are learning in school. All other connections - between one mathematical concept and other, between different mathematics topics, between mathematics and other fields of knowledge, and between mathematics and everyday life- are supported by the link between the learners' informal experiences and a more formal mathematics (p.32).

From the above quotation, teachers need to connect their teaching of mathematics with pupils' prior experience, knowledge and understanding. The experiences and learning that goes on at home and in the community can be very important elements in helping pupils to develop skills and confidence in mathematics (Hannell, 2013).

2.5.8 Problem solving

Problem solving is one of the mathematical skills which everyone should have either in or out the classroom (Chinn, 2004). Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations (ibid). Pupils with low mathematical skills may have problems finding alternative solutions to mathematical problems. Many studies show that pupils with low mathematical skills may lack one of the three domains of math skills which are knowing, applying and problem solving (Männamaa, et al., 2012). Pupils with low mathematical skills should be taught problem solving skills as one of the mathematical skills every individual should have (ibid). Allsopp et al. (2007) argues that, problem solving should be a regular part of classroom instruction to help students with low mathematical skills become critical thinkers and independent learners. According to principles and standards for school mathematics (NCTM) (Number standard for Grades Pre-K-12, 2000) states that: *“Without the ability to solve problems, the usefulness and power of mathematical ideas, knowledge, and skills are limited”* (P.182).

NCTM (2000) advocates teaching and learning mathematics through problem solving. The essentials should be developed through focusing on problem solving and underlying concepts so that students can use ideas that are closer to their ways of thinking, which increases the likelihood success (Allsopp et al., 2007). Jitendra and his colleagues created a small group context for problem solving. Groups consisted of no more than eight low achieving students with learning difficulties. This structure provided opportunities for all students to discuss one or two complex problems. It should be emphasized that students were encouraged to solve each problem collaboratively. Hence they could observe and contribute based on their initiative or when asked by the teacher (Montague & Jitendra, 2006).

3 RESEARCH METHODOLOGY

Chapter three presents the methodology used to seek solutions to the problem and questions under study. This part explains the research design and discusses its advantages and disadvantages. The second part relates to the process of data collection and consists of a sampling procedure, gaining entry into the study, methods and instruments and ending procedure of data collection. The third part presents steps of analysis and embedded arenas of analysis. The chapter concludes with issues pertaining to ethical consideration, validity and reliability.

Quantitative approach is one method of research in which most of an inquiry is presented in numbers (quantity) and is based on variables. Quantitative approach has two types of design which are descriptive research design and casual comparative research design. It uses questionnaires, hypotheses, a large population, and its research questions are highly structured. The main feature of quantitative research is statistical methods used to analyze data, while qualitative use of analytic induction to analyze data (Gall et al., 2007). Although mathematics is mostly used in one of the quantitative approaches such as survey, experiment or quasi-experiment, this study investigator used as qualitative approach based on case study despite the fact that some numbers and figures will be seen as a part of data analysis.

3.1 Research design

Qualitative approach is the method of research in which most of the data is presented in a descriptive form and is conducted in natural settings such as schools, classrooms, families, neighborhood and other places (Bogdan & Biklen, 1992). Qualitative research has five types of design namely: case study, phenomenology, ethnography, grounded theory, and applied research (ibid). Qualitative research uses interviews and observation in data collection. In qualitative research interviews are formatted into three types. First is informal conversation interview which relies entirely on the spontaneous generation of questions and natural interaction and the research participants may not realize that they are being interviewed. The second type is the general interview guide approach which involves outlining a set of topics to be explored with each respondent. The third type is the standardized open -ended interview which involves the same set of questions being asked of each respondent in order to minimize

the possibility of bias (Gall et al., 2007). There are two types of observation in qualitative research. The first one is reactive observation which occurs in real life context and in which research participants know that they are being observed. The second type is the non-reactive observation which involves observations of behavior in which research participants do not know that they are being observed (ibid).

Based on how qualitative research is done and the elements it poses, the investigator has chosen to use qualitative approach in order to find the different methods teachers use to teach children with low mathematical skills. Qualitative research allows researchers to understand the inner experience of participants, to determine how meanings are formed through and within the culture, and to discover rather than test variables (Corbin & Straus, 1996). In line with this de Vaus (2002) argues that “*qualitative methods are often regarded as providing rich data about real life people and situations, being more able to make sense of behavior and to understand the behavior within its wider context*” (p.5). A researcher will base on a case study design in order to be able to answer the questions relevant to this study. The case study method normally focuses on particular instances which are phenomena, unit of analysis, case and focus or aspect (Gall et al., 2007). It tries to develop a full understanding of the case and it is used more in a qualitative research. In this study instances will be phenomenon (teaching methods), case (four mathematics teachers), unit of analysis (grade three classrooms) and focus/ aspect (low mathematical skills).

Gall et al., (2007) defines case study as an “*in-depth study of one or more instances phenomenon in its real- life context that reflects the perspective of the participants involved in the phenomenon*” (p.447). The case study method does not rely on comparing cases but understanding the wholeness of a particular case and attributes of a person (de Vaus, 2002). In line with this, Johnson & Cristensen (2012) argue that, in the case study research, the researcher provides a detailed account of one or more cases, although case study research usually relies on qualitative data, multiple methods are also used.

Case study as one among different research methods has advantages and disadvantages. The first advantage of case study is that, a researcher can bring a case to life in a way that is not possible using the statistical methods of quantitative research (Gall et al., 2007). The second advantage is that a researcher collects sufficient data because the focus is on one or few

phenomena for long time. The third advantage is that, case study reveal the researcher's perspectives (etic), which enables readers to determine the researcher's perspectives towards phenomena. The fourth advantage of case study is that it supports the development of historical perspectives and guarantees high internal validity, which is to say that the observed phenomenon is authentic representation of reality. The first disadvantage of case study is that it involves very time consuming field work. The second disadvantage is that it is very difficult for another researcher to reproduce a case study (external validity). The third disadvantage is that the result cannot be generalized to other findings to other situations (ibid). The approach of using the case study will allow the researcher to investigate deeply into the real situation of the existing problem of the increasing number of pupils with mathematical difficulties in Arusha District Council. Thus, these phenomena will be studied from both researchers' perspectives (etic) and interviewee perspectives (emic) through multiple sources of information that will be gathered through interview and observation. This way of using more than one method is known as triangulation method. Maxwell (2005) argues that, the importance of collecting information using variety methods reduces the risk of chance association and of systematic biases due to a specific method, and allows a better assessment of the generality of the explanation that someone develops.

The investigator will ask mathematics teachers some questions, which are on the interview guide. These questions are concerning the presence of the problem of low mathematical skills, teaching methods, teaching strategies, assignments, teaching materials, teaching through daily life situation, and suggestions. Also, investigator will observe some of the things accompanied with teaching methods which are in the observation schedule. These are: Classroom arrangement and organization, classroom interaction, teaching methods, teaching strategies, teaching and learning materials, teachers' knowledge and experience, lesson plan and scheme of work and time.

3.2 Procedures of data collection

The investigator is planning the data collection process to start from the beginning of September, 2012 and end in the beginning of December 2012. The first stage will involve sampling procedures and efforts to obtain permissions for the study.

Selection of schools: Considering the focus of this study, which involves teaching methods for pupils with low mathematical skills, four primary schools will be purposefully sampled from among one hundred and fifty primary schools in Arusha District Council. The reasons for selecting these four schools first are because the investigator is familiar with the environment and has been living there for three years. The second reason is that all four primary schools are inclusive schools. The third reason is that among of these four schools one of them has been a target schools for various studies. The selected schools may therefore be classified as the good cases. The four schools can therefore give some insight of what is taking place in schools in the Arusha District Council.

Selection of teachers and classes: This study will employ a purposeful sampling. In purposeful sampling, the goal is to select cases that are likely to be information rich with respect to the purpose of the study (Gall et al., 2007). The intention is to select teachers and classes that could provide rich information about the teaching methods for pupils with mathematical difficulties in grade three.

3.3 Gaining entry into the study

Gaining entry into the study needed to secure permission. Cresswell (2009) argued that, it is important to gain access to research or an archival site by seeking approval of gatekeepers. From this argument, gaining permissions into the study occurred at the same time as the purposeful sampling procedures. Permission will be applied for and gained from: University of Oslo, appendix A, Ministry of Education and Vocational Training (MoEVT) appendix B, Regional Education Officer (REO) appendix C, District Education Officer (DEO) appendix D, and permission from the teachers, appendix E.

3.4 Methods and instruments.

3.4.1 Observation

Johnson & Cristensen (2012) defines observation as, “*the watching of behavioral patterns of people in certain situations to obtain information about the phenomenon of interest*” (p.206). Observation may be used as a method within most qualitative designs-, although it is more used in case- studies, where a group of individuals participating in events, activities or

organizations, and in ethnographic studies where entire cultural systems or subcultures are in focus (Cresswell,199).

The main instrument of collecting data will be observation. Since this study is about teaching methods, it is therefore important to observe what the teachers do in the classroom.

Observation often provides a direct and powerful way of learning about people's behavior and the context in which this occurs (Maxwell, 2005). Observation provides rich data sources that offer an in-depth explanation of the case (Gall et al., 2007). In this study the Investigator will observe all teaching methods and strategies which will be used by the teacher during classroom instruction in mathematics to pupils with a focus on those with low mathematical skills. Also, the Investigator will observe documentations such as study books, written work of pupils with low mathematical skills, teacher's lesson plan and scheme of work. The observation method may supplement what the oral interviews may not suffice. This is probably the reason why Gans (1976) says that, "*Participant observation is the only method I know that enables the researcher to get close to the realities of social life*" (p.59).

3.4.2 Observation instrument

The participant observations will be structured by using an observation schedule or checklist to guide the investigator in observing teaching methods in the mathematical classes. The investigator will take field notes on the behavior and activities of mathematical teachers in the classroom. The observation schedule or checklist form will be used as a basic checklist to allow the investigator to be certain that all relevant methods were implemented or not by using Vygotsky's cognitive development theory, Bronfenbrenner ecological system theory and Constructivism theory in teaching mathematics. The observation schedule form is consisting nine areas as indicated in Appendix F.

3.4.3 Interview

The study will involve semi-structured interview with a general interview guide; the approach involved outlining a set of topics to be explored with each respondent. The interview will involve open-ended questions that will be asked of the interviewees as oral-verbal stimuli about mathematics and the methods they use (Kothari, 2007). Punch, (2009) supports Kothari by arguing that, the stimulus-response nature of semi-structured interview stresses rational

rather than emotional responses. Maxwell (2005) argues that, *“interviewing is often an efficient and valid way of understanding someone’s perspectives”* (p.94). From this quotation the investigator will be asking questions by investigating, exploring and analyzing the factors which cause the increased number of pupils with low mathematical skills in the Arusha District Council. The purpose of including an interview is to attempt to understand the phenomenon of teaching methods for pupils with low mathematical skills from the teacher’s point of view (emic perspective).

3.4.4 Interview instrument

The interviews will be voice recorded with permission from the teachers and a prepared interview guide form will be used, appendix G. The investigator also will give the notes to the mathematical teachers to read, so that they can clarify or add if something will be missed or misunderstood. Some of the situations will be repeatedly observed to make it possible for the investigator to ask some questions in later interviews. The teachers will be interviewed about what the investigator observed in the class during the lesson of mathematics.

3.5 Validity

Validity measures what it supposed to measure or that an account accurately represents those features that it is intended to describe, explain or theorize (Winter, 2000). Cohen et al., (2001) argued that, *“validity is an important key to effective research. If a piece of research is invalid then it is worthless”*. Yin (1994) cited in (Gall et al., 2007) mentions three types of validity. The first type is construct validity whereby the extent to which measures used in a case study in which it correctly operationalizes the concepts being studied. The second type is internal validity whereby the extent to which the investigator has demonstrated a causal relationship between X and Y. The third type is external validity whereby the extent to which other investigators would get at similar results if they used the same procedures of data collection as the first investigators.

Data in the research must not only be authentic and believable, but it is worthless unless it is also valid and reliable (Charles, 1998). One of the main characteristics of the case study is the use of multiple sources of information (Creswell 1998; Gall, Gall & Borg 2003; Johnson & Cristensen, 2012; Punch, 2009; Yin, 2003). The triangulation method will be used to address

a single validity threat (Maxwell, 2005). The triangulation method is a strategy which reduces the risk of chance associations and of systematic biases due to a specific method, and allows a better assessment of the generality of the explanations that the investigator develops (ibid). In that sense and with intentions to satisfy the principle of validity, this study will use observation and interviews as research methods for data collection. Investigator will build personal communication in order to deal with biases in the study and took a long time in collecting data with followed observations and interviews so as to collect rich and valid data. Both long term involvement and intensive interviews will enable the researcher to collect data that is detailed and varied enough that it provides a full and revealing picture of what is going on (ibid).

3.6 Reliability

Reliability is the accuracy of work in the research. If the study can be repeated and provide the same result, then the work is reliable (Coleman & Briggs, 2007). From this definition of reliability, the study of investigating teaching methods for pupils with low mathematical skills is reliable for different reasons. First, this work has been repeated several times by many researchers who were investigating the causes of low mathematical skills including teaching methods or teaching strategies. This evidence is shown in the part of literature review. The second reason is retesting. During data collection the investigator will test respondents from piloting study and interview the respondents more than once; this will bring accuracy to the work of the investigator. Cohen et al.,(2007) argues that, *“when tests are developed , they are typically tested for reliability by giving them to a group of people then calling back those same people a week later to take the test again”*(p.49). For example, in Ostad’s study, he retested mathematical less able. The third reason is that, all teachers who teach mathematics in grade three (interviewees) will be asked the same questions which are in the interview guide.

3.7 Ethical issues

It was very important for the investigator to consider ethical issues in order to avoid some of the problems in the study. Identifying appropriate sites and working with gatekeepers in order to obtain permission are critical steps in a case study (Gall et al., 1996). Because the research will be conducted in the four primary schools as institutions, the Investigator will

follow ethical procedures (Gall et al., 2003 & 2007). Ethics covers the whole process of research and it is vital to recognize various sensitive aspects involved in a certain field. As Fluehr-Lobban (1979) says:

This involves considering ethics in every phase of research, from the conception of the research project to the design of the research methodology. This includes how best to obtain informed consent; beginning and sustaining a dialogue about the intent, funding sources, and likely outcome(s); ensuring the voluntary participation of persons involved in the study and asking whether they desire anonymity or recognition; thinking about the impact the study may have on those studied through dissemination of results and publication; empowering those who are studied to ask questions, contribute to the research design, or improve methods; and considering reciprocal acts that might benefit the people or community studied (p.401).

In this study, the investigator will highlight and take into consideration three main issues. One is the recognition of the political and education authority. Second, is respecting and maintaining the informed consent and right of data dissemination from the interviewees and observations. The third issue will be maintenance of privacy and confidentiality.

3.7.1 Protocol recognition and permission

Due to the presence of rules and power relations in the Tanzanian Arusha District Council context, the investigator will need a careful presentation and documentation in order to get permission for conducting the study. Gall et al., (2007) states that, “*when conducting research in institutions, you must follow certain procedures in order to obtain permission for your study and to gain cooperation from individuals who will be affected by it*” (p.88). For example, the hierarchical nature of teacher-pupil relationship does not allow students to speak critically or against their teachers. In that case, if pupils have to give the right, valid and realistic information about the subject of the research, the investigator needs to recognize this ethical dilemma and resolve it by ensuring privacy and anonymous or pseudonymous tactic to the teachers. The same tactic will be used on different sensitive issues that may arise in the field. Here are some of the institutions through which permission will be applied for and gained. The first permission will come from the Ministry of Education and Vocational Training (MoEVT). Because the study will be within an area with political and education leaders, in order to enter into that area the investigator need to ask for permission from such authorities which are the Regional Education Officers (REO) who deals with educational administration in the whole region .The third in line of the protocol to observe was the District Educational Officers (DEO) who deals with educational administration in the District

or area of the participating school. The fourth category is the Head Teachers (HT) of the schools that will be selected for research purpose. The fifth and last category is mathematics teachers who will be observed during classroom observation and interview. These authorities will give the investigator the permission and endorsement for the right to reach the places and find recognition from those to be interviewed.

3.7.2 Informed consent and right of data dissemination

Like what Fluehr-Lobban says in the above quotation, people have the right to be informed of what the research is about and they have the right for the information they present. Also, Gall et al., (2007) states that, “*researchers must inform each individual about what will occur during the research study and information to be disclosed to researchers, and the intended use of the research data that are to be collected*” (p.82). In every step of the research investigation it is necessary to present the nature of the study and ask the interviewees for the information. At the same time informing them of the way the investigator is going to use their information following the objectives of the study. Consent letters also which is introduction letter to the teachers will be given to teachers as indicated in the appendix E. Also, the informed consent form will be given to the teachers to sign and return to the Head Teacher and investigator. Consent form is presented in appendix H.

3.7.3 Maintenance of privacy and confidentiality

Gall et al., (2007) argue that confidentiality must be further protected by not using the names of individuals or sites of any institutions that the study will be conducted unless agreed upon by all sides. For example, the hierarchical nature of teacher-pupil relationship does not allow students to speak critically or against their teachers. The same tactic will be used on different sensitive issues that may rise in the field. In order to secure the schools’ and the teachers’ privacy and anonymity, their names will not be used in this study (only pseudonyms). However, there is still a risk because the teacher and her or his class may be recognized by colleagues and administrators in the participating school. According to ethical issues, the investigator will offer to participate schools a written report and presentation of study on a school meeting and after the study.

4 PRESENTATION OF FINDINGS AND ANALYSIS

Chapter four presents the results collected through two data collection methods, which were observation and interview and their analysis. Mathematics teachers were interviewed and observed in the actual classroom teaching processes. The information from the interview guide and observation schedule was transcribed and analyzed by using questions, Vygotsky's Cognitive Development Theory, Bronfenbrenner Ecological System Theory and Constructivism Theory. The findings are categorized and presented taking into consideration of six main areas: Teachers knowledge and experiences towards low mathematical skills, teaching methods, differentiation, use of concrete teaching and learning materials, connectionism and transformation and problem solving.

Firstly, the study was conducted within four primary schools. These schools had a large number of pupils and shortage of books. These books were teachers guides' books for mathematics and pupils' learning books for mathematics. For example, Teacher 1 had only one guide for teaching mathematics grade three. Teacher 2 had three guides with a different title and different publisher for teaching mathematics grade three. Teacher 3 had five books with a different title and a different publisher for teaching grade three, and the Teacher 4 had two books with a different title and a different publisher for teaching grade three.

Secondly, a third grade class was observed in each primary school. The classes had a large number of pupils. The table below is indicating the number of pupils in the classrooms.

Table 1. *Number of pupils in the classes.*

Class	Number of pupils
Class 1	96
Class 2	83
Class 3	67
Class 4	53

Thirdly, each class had one teacher per subject. Four teachers who teach mathematics were interviewed and observed. Teachers had enough knowledge and experiences in teaching mathematics, but teaching experience varied from one teacher to another. The table below is indicating the sex and years of the teachers in teaching mathematics (teaching experience).

Table 2. *Teaching experience in mathematics.*

Teacher	Sex	Years of teaching mathematics
Teacher 1	Female	34 years
Teacher 2	Female	21 years
Teacher 3	Male	17 years
Teacher 4	Female	11 years

Before the investigation of the teaching methods which teachers use to teach all pupils with and without low mathematical skills, the investigator first observed classroom setting, availability of teaching and learning materials, and time used on mathematics per period.

Classroom setting: Classroom setting is one of the factors that contribute to the determinants of teaching methods which the teacher uses to facilitate learning. All classrooms investigated were found to be poorly suited for teaching and learning mathematics for pupils with low mathematics skill. For instance, all classrooms lacked display of teaching/learning materials on the wall such as the flip charts showing different formulas, multiplication table, mathematical set instruments, geometrical photos, and some mathematical figures. In the case of sitting arrangement, most of the pupils were interested to sit with the same sex and one desk was shared by five pupils. Pupils with low mathematical skills preferred to sit at the back in the class. No chair and table were available for the teacher in the classrooms; teachers used a desk as multipurpose furniture.

Teaching and learning materials: Teaching methods depend on teaching and learning materials that teachers use effectively during the teaching and learning process. In this study, the investigator observed how the teachers were effectively using the teaching/learning aids; and the way in which the pupils with low mathematical skills were using the learning materials.

Also, the investigator interviewed teachers about the way they use teaching/learning aids with their lesson plan, and scheme of work. Moreover, how do they incorporate manipulative and hands on activities for pupils with low mathematical skills? The teaching and learning materials are divided into three categories as per the investigator's observation. The categories are teachers' guides, lesson plan and scheme of work, and teaching aids.

Table 3. *Different types of Teaching and Learning Materials.*

Teaching Materials	Learning Materials
Teachers guides	Pupils text books
Lesson plan and Scheme of work	Pupils note books
Teaching aids	Pupils learning objects

Teachers' guides: Teachers used their mathematics teachers' guides as one of the teaching materials. They used the guides to teach pupils by citing examples and giving an assignment to pupils. All four teachers had different teachers' guide and every one taught according to his or her choice and interest within the book.

Lesson plan and Scheme of work: The investigator observed all the teachers' lesson plans and scheme of works to find out whether they were following their teaching procedures in the actual classrooms. Most of the teachers prepared their scheme of works and lesson plans. For the case of the scheme of work, they prepared well according to the content, objectives and aims of the lesson. This was done so because they prepare it once per year during December for the coming year according to the syllabus. But, some of the teachers did not indicate what teaching aids were supposed to be used in the particular lesson. For the case of lesson plans, Teacher 3 prepared one daily while Teacher 1, Teacher 2 and Teacher 4 did not prepare one daily. The lesson plan is supposed to match with the scheme of work and be prepared daily so as to guide the teacher on how to teach a particular lesson. For example, the investigator observed the lesson plan of Teacher 4 and found that the teacher did not follow her lesson plan such as the topic, sub topic, teaching methods, teaching strategies and teaching aids as indicated in the scheme of work.

Teaching and learning aids: The teachers used different resources in facilitating learning. These teaching aids were: bananas, sticks, bottle tops, matchboxes, strings, notes and coins, stop watches, pieces of wood, clay, tins, seeds, bags, bottles, and counts to mention few. The teaching and learning resources activated and involved pupils to undertake practical activities, motivated pupils to learn, made idea concrete and presented mathematics in the real world. Particularly, the learning materials included text books for pupils and concrete objects. Through observation and interview, text books for pupils to use in the classroom and to bring them back home were very few. Generally, there was no independent learning after the class hours.

Time organization and management: During classroom observation for teaching methods, the investigator observed how time was organized and managed. The investigator observed how the teachers organized and managed time to introduce new ideas, time for pupils with low mathematical skills spent for undertaking the given task, time for pupils to ask questions, time to help pupils with low mathematical skills during teaching methods and time for specific lesson evaluation. The mathematical lessons lasted 40 minutes. These 40 minutes were categorized into four main parts in which 5 minutes was for introduction, 15 minutes for building new knowledge, 10 minutes for reinforcement, 5 minutes for reflection and 5 minutes for conclusion. This time was not enough for helping pupils with low mathematical skills as all the observed classes had a large number of pupils.

4.1 Teachers' knowledge and experiences towards low mathematical skills

Teachers' knowledge and experience towards low mathematical skills was investigated. The investigator wanted to know whether there was a problem with low mathematical skills among pupils by asking mathematics teachers the following question: *"Do you think there are problems of low mathematical skills in your class in inclusive school and why?"*

All four teachers replied that there were pupils facing problem of low mathematical skills at their school. The reasons which cause low mathematical skills were mentioned and explained. These reasons were: dyscalculia, lack of listening skills, shortage of teaching and learning materials, incapability of following instructions, large number of pupils, lack of reading and writing skills, poor teaching methods, unfriendly teaching and learning environment, parents' negative attitude towards mathematics and lack of teachers' professional development.

4.1.1 Lack of listening skills

Listening skills is important for pupils to have during classroom instruction. Teachers said that the problem of low mathematical skills is caused by pupils themselves by not listening to the teacher in class. For example, Teacher 1 said: *"pupils themselves are not keen in listening what I'm teaching in the class"*. From this point of view, the investigator observed that some pupils were playing when the teacher was teaching mathematics and others were sleeping on

the desk. For example, in the class of Teacher 2, three pupils were playing with counts (bottle tops) instead of listening to the teacher.

Subtheme analysis: Through observation and the above responses show that some of the pupils were not listening their teachers. Due to the large numbers of pupils, teachers did not react to pupils who were not listening.

4.1.2 Shortage of teaching and learning materials.

All teachers claimed that, low mathematical skills are caused by the shortage of teaching and learning materials. Pupils do not have enough text books for independent study. For example, Teacher 2 said: *“I have only 8 text books and the number of pupils are 96”*. Also, in some classes which have books, teachers do not allow pupils to go with books for independent learning. Teacher 4 said: *“I cannot give pupils text books to take back home because I fear that books can be destroyed, are dirty and at the same time can be lost”*. The investigator observed that there was a shortage of text books in all schools. Pupils did not have text books to read and take back home. For example, the pupils – text books ratio for the Teacher 1 was 1:8, Teacher 2, was 1:6, Teacher 3, was 1:7 and Teacher 4 was, 1: 5.

Subtheme analysis: The above responses and through observation there was a shortage of mathematics book in all classes investigated. Due to this situation there was no independent learning after the class hours due to severe shortage of text books.

4.1.3 Following instructions

All teachers said that most of the pupils do not follow instructions and that is why they face the problem of low mathematical skills. Teacher 1 said: *“pupils do not follow the examples which I give them”*. This also was observed when Teacher 3 was giving examples on the topic of multiplication; some pupils did not follow what the teacher was teaching about on how to use seeds as counts. For example, when the teacher posed this question to pupils: *“ $3 \times 4 = ?$ ”* Instead of using seeds as counts, three pupils with low mathematical skills liked to draw on their desks to solve the task. These are the two examples which the investigator observed during solving the question.

A) $\blacksquare\blacksquare\blacksquare + \blacksquare\blacksquare\blacksquare + \blacksquare\blacksquare\blacksquare + \blacksquare\blacksquare\blacksquare = 11$

B) $\bullet\bullet\bullet + \bullet\bullet\bullet + \bullet\bullet\bullet + \bullet\bullet\bullet = 13$

Figure 2. Pupils solving without following instruction and provide a wrong answer.

By using drawings and not following instruction these two pupils got the wrong answer. If they could follow their teacher they could get the correct answer which is 12. Also, due to a large class size and lack of assisting teachers, a great number of pupils were not following instructions because no one was supervising and managing them.

Subtheme analysis: Under this subtheme, through observation some of pupils with low mathematical skills did not follow the instruction. Also, due to the large class size and lack of assisting teachers, a great number of pupils were not following instructions because no one was supervising and managing them.

4.1.4 Large number of pupils

All teachers said that low mathematical skills are caused by the large number of pupils in the classes. Due to this challenge teachers failed to control and manage all pupils during the teaching and learning process. For example, Teacher 1 said: *“the number of pupils is too large to accommodate each pupil during teaching/learning process, as I mentioned before that I have 96 pupils in the classroom and pupils with mathematical difficulties are about 35”*. Also, Teacher 3 said: *“the number of pupils is great which cause me not see every child in the class. I have 83 pupils in my class and the time for teaching mathematics is just 40 minutes, this time is not enough compared to the number of pupils”*.

Subtheme analysis: Through observation and the above responses, the large number of pupils was observed in all the teachers' classes and this as a cause of low mathematical skills was evident. Reducing class size is very important as one factor in reducing the problem of low mathematical skills among pupils.

4.1.5 Lack of reading and writing skills

All teachers said that low mathematical skills are caused by lack of reading and writing skills. They said that there are some pupils in grade three who do not know how to read and write.

Teacher 3 said: *“it is difficult to know mathematics while you don’t know even reading a word”*. Also, Teacher 2 said: *“some of the pupils do not know how to read even a single word. Due to this reason, they can’t know even numbers in mathematics”*. Also, this was observed in one pupil when was asked by the teacher to write numbers in words. For example, Teacher 4 wrote 5698 and asks this pupil to write it in words and the pupil failed.

Subtheme analysis: It was observed that some of pupils with low mathematical skills did not know how to read and write numbers. Teacher 2, Teacher 3 and Teacher 4 have already arranged remedial classes for these pupils. Streaming and remedial class can be one way of helping these pupils. This is because the time for helping pupils with low mathematical skills during mathematical lessons is short (40 minutes). Thus, if they attend remedial class they can get enough opportunities to learn.

4.1.6 Teaching methods

Among the four teachers, there was only one teacher who claimed that the low mathematical skills are caused by using few teaching methods. Teacher 4 said: *“as I taught these pupils for 34 years, teaching methods can cause this problem to become large. For example, due to class size and large number of pupils I can’t use variety of teaching methods such as group discussion and games. I normally use lecture and questions and answer methods mostly”*. From this quotation of Teacher 4 it was true that low mathematical skills are caused by not having enough teaching methods. From observation, most teachers didn’t prefer some of the teaching methods such as group discussion, games and demonstration.

Subtheme analysis: It is generally observed that, most of the teachers did not use some of the teaching methods such as group discussion and games. The saying such as-, *“due to class size and the large number of pupils I can’t use a variety of teaching methods such as group discussion and games”* is the indicator. Little use of the varied teaching methods was caused by class size and the large number of pupils.

4.1.7 Teaching and learning environment

One teacher said during the interview that low mathematical skills are caused by unsuited teaching and learning environment. Teacher 1 said: *“we have unfriendly teaching and*

learning environment. You may look that there is no chair and table for teacher in the class as well as four pupils have to share one desk”.

Subtheme analysis: The investigator observed that in all classes there were no display material on the walls which shows a calculation of mathematics such as a multiplication table, mathematical set instruments, geometry, drawings and photos concerning mathematics. Also there were no chair and table for teachers; instead some of the teachers used a desk as multipurpose furniture. A teaching and learning environment should be one of motivation for both teacher and pupils so as to cultivate and enhance teaching and learning processes in the mathematical subjects as well as other subjects.

4.1.8 Parents’ negative attitude towards mathematics

Through the interviews three teachers said that there are negative attitudes towards mathematics among most of the parents. Parents tell their children that: *“mathematics is the most difficult subject to all subjects”*. Teacher 4 said that: *“when a child hears this immediately starts building math anxiety and hate mathematics as well as see mathematics as a difficult subject”*. For example, Teacher 2 said: *“people who are living with these pupils like parents, brothers, sisters, uncles, aunts, and other members in the family tend to tell these children that mathematics is a difficult subject. If a pupil hears this, he or she build a certain situation of fearing and hate mathematics due to the wrong notion and myth from the family members”*.

Subtheme analysis: From the responses above, experiences of the interviewees show that there is no cooperation between teachers and parents with children with low mathematical skills. Due to the parents’ negative attitudes towards mathematics and lack of cooperation results between parents and teachers, the pupil will suffer. Also, family members can be a catalyst in making children love mathematics subjects.

4.1.9 Capacity building

Lack of capacity building seemed one cause of the low mathematical skills. From all teachers investigated no one had ever attended any workshop or seminar for mathematics. This can be verified from answers of two teachers. Teacher 4 said: *“for 34 years being teaching, I have*

never attended any seminar or workshop concerning mathematics. Eh... I remember now, I attended three days seminar which was on social study subject". Also Teacher 3 said: "People from the Ministry of Education and Vocational Training are not motivating us teachers by giving seminars. Due to this circumstance, I have no time for looking every pupil whether has understood or not".

Subtheme analysis: From the two quotations above, it seems that some mathematics teachers have low motivation for teaching mathematics due to the fact that they don't get to attend seminars and workshops on mathematics. Seminars and workshops are very important for teachers because they help teachers to acquire new knowledge, skills, teaching methods and teaching techniques of mathematics subject.

4.2 Teaching methods

Teachers used different teaching methods during mathematics lessons. All teachers identified all teaching methods which they use in teaching both pupils with and without low mathematical skills. The investigator wanted to know the kind of teaching methods do these teachers use in order to improve the abilities of pupils with low mathematical skills with the following question: *"Please tell me what kind of teaching methods do you normally use in order to improve performance of pupils with low mathematical skills?"* Teacher 1, Teacher 2, Teacher3, and Teacher 4 collectively identified eight teaching methods which they use in teaching mathematics. One or two methods were used during the single lesson of mathematics and not all methods were applied by all teachers involved in the study. The table below shows these methods.

Table 4. *Different types of Teaching Methods.*

Pupils' participation	Pupils participate with teachers
Games	Develop math skills, understanding of math concepts
Demonstration	Use of concrete and semi concrete objects
Problems & Puzzles	Develop thinking capacity, encourage learning
Oral & Written Testing	Gives opportunities for practice
Group discussion	Encourages peer support and interaction
Questions & Answers	Learn through prior knowledge and scaffolding
Lecture	Introduces new ideas , used for a large group

4.2.1 Pupils' participation

Pupils' participation is a teaching method that provides active involvement for both teacher and pupils to engage in study. All teachers used this method in which they cooperated with their pupils in solving the question together. For example, Teacher 1 asked the question to pupils: *"How many hours within one day?"* Pupils replied: *"Twenty four hours"*. Also, Teacher 4 cooperated with her pupils to solve the question which seemed to be complicated for most pupils. See figure 1.

$$31 \div 3 = ?$$

Figure 3. Division.

Pupils said: *"the answer is 3"*. Teacher 4 replied: *"no"*. Teacher 4 calculated this question on the blackboard and showing pupils how the answer is obtained. Teacher 4 told pupils that: *"the answer is 10 remains 1, not all numbers will be divided and you get a complete answer like 30 divide by 10 is equal to 3"*.

Subtheme analysis: As the findings shown above, when using the pupil participation method, no teacher mentioned the name of one pupil to answer the question; instead all pupils answered the question at once. Teachers called these answers *"chorus answers"*. Through participatory method, teachers helped pupils to answer the question which seemed to be complicated to them. Most of the pupils without low mathematical skills cooperated with their teachers to answer the question in a loud voice while few pupils with low mathematical skills responded in low voices thinking that their answers were not correct while the rest kept quiet.

4.2.2 Games

Using games is one of the teaching methods which the teacher uses to make mathematics class very enjoyable, exciting and interesting. The game method was used by the two teachers only, Teacher 1 and Teacher 3. For example, Teacher 3 used the game method when he was teaching multiplication concepts. He took the pupils outside the class and told them run around the football field four times. Before the pupils run around the football field he told them that: *"This football field has 100 meters, so round 4 times and you will tell me how many*

meters have you rounded”. After the pupils finishing going around the football field they answered the teacher that they rounded 400 meters.

Subtheme analysis: Through observation, using mathematical games helped pupils to understand mathematical concepts, develop mathematical skills, know mathematical facts, learn the language and vocabulary of mathematics and made pupils to enjoy the lesson. Also, games made the mathematical class very enjoyable, exciting and interesting. These mathematical games provided opportunities for both pupils with and without low mathematical skills to be actively involved in learning.

4.2.3 Demonstration

The demonstration is a teaching method which helps learners to understand, learn, and appreciate a particular subject matter demonstrated by the teacher. All teachers used concrete and semi concrete objects during the demonstration except Teacher 1 who said that she did not have a flip chart. They demonstrated step by step when they were teaching pupils. For example, Teacher 2 demonstrated the topic of money by using Tanzanian notes and coins. Teacher 2 showed all pupils notes and coins and identifying their features and colors. She demonstrated a note of 10,000/= note, 5,000/= note, 2,000/= note, 1,000/= note, 500/= note, 200/= coin, 100/= coin and 20/= coin. After the demonstration, the teacher provided some questions on the blackboard and asked all pupils to do on their exercise books for ten minutes. These questions were:

- i. How many 500/= notes in one 2,000/= note? ,
- ii. How many 1,000/= notes in one 10,000/= note?
- iii. How many 1,000/= notes in one 10,000/= note?
- iv. How many 200/= coins in 1,000/= note?

Subtheme analysis: Findings show that, demonstration can be used to provide examples that enhance lectures and offer effective, hands-on, inquiry-based learning opportunities in mathematical classroom. Also, after performing demonstration, the teacher’s role became supporting pupils in their attempts, providing guidance and feedback, and offering suggestions for alternative approaches.

4.2.4 Problems and puzzles

Problems and puzzles is a teaching method which involves encouraging pupils to learn mathematics through solving problems and puzzles which have definite answers. The key feature of problem-solving is that pupils have to work out the method for themselves. All teachers used this method in teaching mathematics. For example, Teacher 3 provided one puzzle as follows:

Teacher 3: *“Saitoti boils one egg for 5 minutes and be ready for eaten. For how many minutes will it take to boil three eggs and be ready for eaten?”*

Pupil 1: *“Fifteen minutes”*

Teacher 3: *“No”*

Pupil 2: *“5 minutes”*

Subtheme analysis: Through observation, findings revealed that, problems and puzzles method encouraged pupils to learn mathematics through solving problems and puzzles which had definite answers. Most of pupils with low mathematical skills they failed to associate mathematics with their daily life situation. Puzzles questions develop students’ thinking skills.

4.2.5 Oral and written testing

Oral and Written testing is a method which teachers used to evaluate their pupils. Sometimes known as the “quiz” method, it was used by all teachers. All teachers used this method after finishing a topic. For classes with more pupils, oral testing was used. Teachers provided some questions in order to evaluate how many pupils had understood the topic, teachers ordered pupils to perform the task on their exercises books. Normally these tests were simple and few in number. Some teachers provided two questions while others posed three to five questions. This was done in the class and the teachers marked the questions and gave corrective feedback before continuing to the next topic. For example Teacher 3 provided written testing to her class. The table below is indicating the written test for number knowledge.

Table 5. *Number knowledge test.*

Question	Work	Answer
1. Which difference is smaller: 80 and 99, and 110 and 105		
2. What number comes after 999?		
3. How many numbers are there between 655 and 700?		

Subtheme analysis: Through observation, oral and written testing method was useful because it helped teachers to determine the independent level of mastery for every pupil in the subject of mathematics.

4.2.6 Group discussion

Group discussion in simple terms is a discussion among a group of people. Group discussion was the method which was used by one teacher among four teachers while the other three teachers were using small groups. When the investigator observed this situation, she asked the following question of the three teachers;” *Why don’t you use group discussion method?* “Teacher 1 and Teacher 2 provided the same answer that: *“I have a large number of pupils in the class”*. Teacher 3 said: *“I can’t use group discussion method because these pupils are very young”*. Teacher 4 was the one who used group discussion occasionally. She had 53 pupils in the class and she used to divide the pupils into 7 groups and give them question to discuss. During group discussion, there were some pupils who wanted to dominate the group while others were just listeners. Others were contributing while a few of them were playing.

Subtheme analysis: Through observation, group discussion method helped pupils with low mathematical skills to reduce fear in front of their peers. Also, pupils felt safe and free in contributing mathematical ideas.

4.2.7 Questions and answers

Questions and answers is the method used by the teachers to pose questions to pupils and for pupils to give answers to their teachers. This method was the most used method; it was used by all teachers involved in the study. Teachers used this method to ask pupils questions by using their prior experience. For example, Teacher 1 asked pupils one question as follows;

Teacher 1: *“Bakari carried basket which contained 12 eggs. Unfortunately, when he saw a bus he run away and causes 5 eggs are broken. How many eggs remained safe?”*

Pupils: *“7 eggs”*

In this method, most of the teachers wrote questions on the blackboard and asking one pupil to go in front to solve it.

Subtheme analysis: Through observation, most of the pupils who were pointed to by the teacher were those who have no problem with low mathematical skills. Most of the teachers did not point to pupils with low mathematical skills and they ignored them because teachers knew that they could get a wrong answer and time for helping them was short.

4.2.8 Lecture

Lecture is a teaching method which involves the teacher presenting and explaining mathematics to the whole class. All teachers identified lecture as one method they use in teaching mathematics. Through the observations this method was used when the teachers were presenting and explaining new mathematical topics to the whole class. The teachers planned the content to be taught, they identified some of the key points and organized them in logical order, they chose examples to illustrate each key point and they prepared teaching aids in advanced. Also many semi abstract and concrete objects were frequently used. For example, the topic of place value by using subtracting back or bridging back was difficult to most of the pupils especially pupils with low mathematical skills.

Subtheme analysis: Through observation, the lecture method was a very effective way of teaching mathematics to a larger group. Sometimes it was difficult to use the lecture method because teachers had to ensure that all pupils understood what was taught by their teacher. All in all, there was little use of teaching methods such as group discussion, demonstration, games, storytelling, question and answers, and songs because of the low mathematical skills among pupils. Pupils with low mathematical skills can become competent if they are taught with all of these methods. Teachers should include mental activities, practice activities and application activities when teaching mathematics in order to reduce the problem of low mathematical skills among pupils.

4.3 Differentiation

Teachers used different teaching techniques which teachers use in order to meet the learning needs of pupils. The investigator wanted to know the teaching techniques teachers used to teach pupils with low mathematical skills. The investigator asked teachers the following question, “*Can you describe how you use different teaching techniques to meet the needs of pupils with low mathematical skills in and out the classroom?*” All Teachers replied that they use many teaching techniques to help pupils with low mathematical skills. These techniques were: problem solving, guided participation, use of small groups, provision of more examples and peer tutoring.

4.3.1 Guided participation

All teachers said that they normally assist pupils with low mathematical skills especially when they are in their class. From the observation that was done by the investigator, only two teachers among four teachers were found to help pupils with low mathematical skills in the class. Example, Teacher 2 helped pupils with low mathematical skills with how to solve the task by drawing the required place and taking the answer from bottom up. When the investigator asked the two remaining teachers who did not help pupils with low mathematical skills during classroom instruction, they replied the same answer. Teacher 1 and Teacher 3: “*There is no enough time for helping each pupil with low mathematical skills during mathematical lesson; instead I normally help them during remedial class hours*”. Also these teachers added by saying that: “*the good time for helping pupils with low mathematical skills is during when they are in their classes. This is because we use more time to teach them and it takes time for them to get the concept*”.

Subtheme analysis: Through observation and responses above, most of the teachers did not assist pupils with low mathematical skills during the mathematics lessons due to the large number of pupils and short time. This is verified from saying above, “*there is no enough time for helping each pupil with low mathematical skills during mathematical lesson*”.

4.3.2 Use of small groups

All teachers said that they normally use the small group as a technique to help pupils with low mathematical skills. Teacher 1 said: “*The class has many pupils and one desk has to be*

shared by four pupils". It was observed that, teachers gave tasks to four pupils who were sharing one desk. Teachers used small groups of pupils to work on activities, problems and assignments. After finishing these tasks teachers told pupils to exchange their exercise books and write their answers on the board. Each small group marked another group by using the teachers marking scheme on the blackboard.

Subtheme analysis: Through observation, use of a small group increased participation and achievement among pupils especially pupils with low mathematical skills. Small group work was the most valuable way of helping pupils with low mathematical skills when the class had a large number of pupils and it increased participation.

4.3.3 Error correction and corrective feedback

Error correction and corrective feedback is a technique which teachers use to help pupils by correcting mistakes and showing answers as well as giving pupils their work and emphasize that they make corrections. All teachers said that they normally make corrections in the class and emphasize that all pupils make corrections. Teacher 1 said that: *"I emphasize pupils who made mistakes to make corrections especially the pupils with low mathematical skills."*

Teacher 4 said: *"Making correction and giving feedback is done before starting the lesson or if three quarter of the class has failed an assignment"*.

Subtheme analysis: Through observing the exercise books of pupils with low mathematical skills some of them did not make corrections while others did correct wrong answers. Also, there were some teachers who did not mark corrections made by pupils with low mathematical skills.

4.3.4 Provisional of more examples

Examples are different cases which teachers use to help pupils to learn the concepts and understand the content of the subject. All teachers answered that when teaching they normally provided more examples so that pupils could understand the lesson. By providing many examples, pupils could follow all procedures used by the teacher until she gets an answer.

Teacher 2 said that: *"Giving more examples helps slow learners to understand mathematics."*

Teacher 3 said that: *"I always give more examples to the topics which seem to be complicated"*

to the most pupils with low mathematical skills such as place value by using bridging through ten and subtracting back”.

Subtheme analysis: Through observation, some of pupils with low mathematical skills wrote few examples which were provided by their teachers while others did not write all examples.

4.3.5 Peer tutoring

All teachers said that they normally emphasize peer tutoring in the class and tell pupils to help each other. For those who have no low mathematical skills were asked to help those who had low mathematical skills. For example, Teacher 1 said: *“I give the task to faster learner in mathematics to help pupils who do not know mathematics”*. Teacher 2 said: *“I ask both pupils with and without low mathematical skills to ask their older brothers, sisters, uncles and aunts to teach them at home”*, Teacher 4 said: *“In my class, most of the pupils who know mathematics are boys. I arrange boys and girls to sit together and emphasize them to help each other; some of the girls like to segregate themselves from boys”*.

Subtheme analysis: It was observed that, no peer tutoring was conducted in the classes throughout the whole period of the study. Perhaps it was done before the time of the study. Different teaching techniques helped teachers to meet the learning needs of pupils or the diversity of pupils in the mathematics classes.

Comment to the above findings: Different teaching techniques helped teachers to meet the learning needs of pupils to some extent. This is because the number of pupils with low mathematical skills was large in the classes.

4.4 Use of concrete materials

Concrete materials are the tangible and observable objects which teachers and pupils use in teaching and learning process. The investigator observed the effectiveness of teaching aids especially concrete objects and the way pupils with low mathematical skills used learning materials. Most of the teachers used concrete objects which were within their environment and easy to be obtained. These objects were: bananas, stop watches, notes and coins, sticks,

bottle tops, bottles, string and rulers and clay. The table below shows all objects and topics for which they were used.

Table 6. *Concrete objects and topics.*

Object	Topic
Bananas	Fractions
Stop Watches	Time
Notes and Coins	Money
Sticks and Bottle tops	Additions and Subtractions
Bottles	Capacity
Clay	Weight
String and Rulers	Length

Bananas: Some of the teachers used concrete objects and others used semi concrete objects in teaching the topic of fractions. Teacher 2 used a banana to teach pupils the topic of fractions. She took a knife and cut the banana into small pieces and with this introducing the concept of the whole thing (1), half ($\frac{1}{2}$), quarter ($\frac{1}{4}$), three quarter ($\frac{3}{4}$), and so forth. After finishing this task, teacher drew boxes and tells pupils to cut it and shade the numbers. See the figure below.

$\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{3}{6}$, $\frac{2}{4}$, $\frac{5}{7}$, $\frac{4}{9}$ and $\frac{1}{10}$.

Figure 4. Fractions numbers.

By using a banana in teaching the topic of fractions, pupils enjoyed the lesson and teaching using banana made ideas concrete. Three pupils took rough paper and cut it into small pieces and ask each other.

Stop watches: all teachers used stop watches in teaching the topic of time. They taught pupils how the stop watch works with hours. They explained the concept of the long arrow and short arrow which are within the stop watch. They taught the concept of, clock, hour, minutes, quarter, half, to and past. For example Teacher 4 after finishing the concept of uses of the long arrow and short arrow, twisted arrows in different ways from the number one to twelve within the stop watch and asked different questions.

Notes and Coins: All teachers used the Tanzanian notes and coins to teach the topic of money, though the tasks in the books used shillings and cents. Teacher 3 taught the features

and colors of each note and coin. For example, the following Tanzanian notes and coins were used as concrete objects by the Teacher 3: 10,000Tsh, 5,000Tsh, 2,000Tsh, 1,000Tsh and 500Tsh. Examples of Tanzanian coins were: 200Tsh, 100Tsh and 50Tsh. Pupils enjoyed the lesson of shillings and cents because they use the money every day by buying ice-cream, sweets, bites, biscuits and so forth. When teacher provided the above task, no pupil failed.

Sticks and bottle tops: All teachers ordered their pupils to come with sticks and bottle tops for the topic of addition and subtractions. Some of the pupils brought bottle tops while others brought sticks. Teachers taught pupils by counting those objects. For example Teacher 2 taught pupils how to add buy using bottle tops or sticks. Teacher 1 provided the task of place value on bridging through ten while Teacher 3 provided the task for place value on subtracting back or bridging back. Few pupils with low mathematical skills were playing with bottle tops when teacher 3 was giving instruction. Others were not using those sticks but instead they drew on their exercise books.

Bottles: The teachers used different bottles when they were teaching the topic of capacity. They taught pupils different concepts in this topic such as liter, milliliter, centiliter, deciliter, hectoliter, kiloliter with much emphasis on the liter. They put water in the bottles and showed pupils different volume size. The teachers elaborated more on the concept of a liter, half liter, quarter liter, three quarter liter and so forth. For example, Teacher 1 showed pupils these bottles and asked them to identify the types of liquid their parents ask them to buy or use at home. By using bottles, pupils understood the lesson of volume easily.

Clay: Some teachers used clay soil to teach the topic of weight. Teachers used clay soil to teach the concept of weight by teaching the concept of a gram, milligram, centigram, decigram, decagram, hectogram with much emphasis on the kilogram. For example, Teacher 4 put clay soil into different unused margarine containers. Teacher 4 gave pupils these containers to carry and sense the weight of each container. Also, Teacher 2 taught pupils that we use weight when we buy salt, sugar, meat and flour. Teacher asked pupils to mention other items measured by weight at home, in shops and at the market. Using containers filled with clay, pupils mastered concepts by connecting their home environments to mathematical subjects.

String and Rulers: Teachers used string and ruler when teaching the topic of length. Teachers taught pupils the topic of length by imparting the concept of a meter, millimeter, centimeter, decimeter, decameter, hectometer with much emphasis on the meter and kilometer. For example, Teacher 1 taught pupils by measuring the four sides of the classroom. The two sides which were horizontal had 12 meters while the other vertical side had 15 meters. Pupils enjoyed the lesson and they asked to measure their football ground length by using string and teacher's ruler.

Comment to the above findings: Generally, by using concrete objects, pupils with low mathematical skills were well motivated to learn and actively involved in tasks and participated in hands-on experiences.

4.5 Connectionism and transformation

Connectionism is the process of associating one thing with another through experience. This was discovered when the investigator asked teachers how they teach pupils with low mathematical skills by transforming a concrete object into the abstract learning to the pupils with low mathematical skills. The following question was asked: *“Can you describe how you transform a concrete object into the abstract meaning to the pupils with low mathematical skills?”* In this question all teachers answered that they transform concrete to abstract by using home environment and concrete objects such as cattle, chicken, ship, goats and other animals. Also they teach pupils by using crops such as bananas, beans, maize and other crops. For example, when discussing the topic of money, all teachers used notes and coins to guide pupils from concrete to abstract. Teachers integrated different issues in mathematical concepts by using daily life situations of pupils by giving them different mathematical tasks or problems. Thus, some of the exercises were in the following form:

Teacher 1: *“Suppose you are given the task to collect money for your friend who lost his father, your uncle gives you 50 Tsh, your our aunt gives you 70 Tsh and your cousin gives you 90 Tsh. How much money will you collect for your friend?”*

Also, when Teacher 2 was teaching the topic of weight, she told pupils that if you go to the shop to buy salt, sugar and rice we normally order it by using kilogram, for example one kilo of salt, two kilos of rice and so forth. By connecting home environment to mathematical

concepts, most of the pupils understood the lesson on weight. Teacher 3 used symbols when he drew different objects so that pupils could understand the meanings. For example, when he was teaching the topic of multiplication, he drew different symbols. Teacher 3 said: “I prefer to use drawings and concrete objects for transformation and connectionism. For drawings, I like to use it on the topic of multiplication. I tell pupils to draw seed, beans and bananas and after that I give them the task. By connecting symbols and real objects, pupils with low mathematical skills understand and get the mathematical concept easily”. Teachers also used pupils’ prior experience when teaching them transformation and connectionism. Teachers said that pupils come to school with mathematical knowledge from home. For example, Teacher 1 said: “I use pupils’ knowledge to teach them by using things they saw and know from home and other places”. Also, Teacher 4 asked pupils this question,

Teacher 3: “*How many litters can fill one tin of water?*”

Pupils: “*20 liters*”

Comment to the above findings: By connecting home environment to the mathematics concepts by using concrete objects, the concept of transformation and connectionism helped pupils with low mathematical skills to understand the meaning. Also, by using the pupils’ prior experience, it was easy for them to discover the means of solving problems. By using daily life situations in their teaching, the teachers imparted the concept of connectionism, transformation and focus on meaning.

4.6 Problem solving

Problem solving is the way teacher teach a new skill and pupils learn a new concept by completing the task or solving the question. It was observed that teachers gave pupils many tasks to perform. Also, problem solving mentioned during the interview when the investigator wanted to know the kind of activities which teachers give pupils with low mathematical skills. The following question was asked: “*What kind of activities do you give pupils with low mathematical skills?*”

All teachers answered that they normally give many tasks and problems to solve to the pupils with low mathematical skills. After teaching they normally write the questions on the blackboard and select three to four pupils to solve the task in front of the class. This normally

is done for the class with a large number of pupils. The Teacher 1 and Teacher 4 said that: *“I provide two to three questions to all pupils so that I can evaluate whether the new skills imparted was well known or not to most of the pupils especially with low mathematical skills.”*

In addition to that, Teachers 2 and Teacher 3 said that: *“I usually teach pupils with low mathematical skills to learn a new concept while solving the problem. They learn new a concept by doing different task or assignment”*. For example, when they were learning about time by using short and long arrow, Teacher 3 twisted the stop watch and asked three pupils with low mathematical skills the following question:

Teacher 3: *“Which arrow is indicating the time?”*

Pupils: *“Short arrow”*.

Also when they were learning about fraction, Teacher 4 gave pupils the task of drawing and shading some boxes to illustrate fractions.

Another answer was practice. This point was discussed by the two teachers. Teacher 2 said: *“I emphasize the pupils with low mathematical skills to do many tasks wherever they are such as at school, home, grazing and other places”*. Teacher 4 said: *“By giving adequate practice opportunity helps pupils to be perfect”*. Teacher 4 added by saying that: *“the time where there is no teacher in the class I give some questions to pupils with low mathematical skills so that they cannot be idle”*.

Furthermore, different activities were provided for pupils with low mathematical skills.

Different groups were usually given different activities on the same topic. All the teachers said that they usually give pupils activities according to their level of understanding. Teacher 2 said that: *“pupils with low mathematical skills normally are given simple activities compared to pupils without low mathematical skills. As they go on they learn from simple to complex or from known to unknown”*.

Comment to the above findings: From all responses above and the observations made by the investigator, different activities and more practice were provided for pupils in the mathematics classes. Solving problems helped some pupils with low mathematical skills to be competent and perfect. Problem solving, guidance and interaction take place during the teaching and learning of mathematics to pupils with low mathematical skills.

4.6.1 Guidance

Guidance was observed when the investigator asked teachers how they differentiate independent level of mastery to each pupil. The following question was asked: *“May you briefly tell me how you differentiate the independent level of mastery to pupils with low mathematical skills?”*

All teachers replied that they differentiate each pupil’s independent level of mastery to each pupil through questions, assignments, weekly tests, monthly tests, semester exams and annual exams. Teacher 3 said that: *“By assessing pupils regularly helps me to know who is capable and not. After discover every learner’s weakness, is where I can go to help a failed pupil”*. Teacher 2 said that: *“This is a good way which helped me to determine pupils who don’t know how to read and write numbers”*. All teachers said that the practical guidance is usually provided to the pupils with low mathematical skills. This guidance is done through assignments and individualized work. For example, Teacher 1 helped one pupil who had low mathematical skills to solve one question of place value by using bridging through ten. When teacher 1 realized this pupil was facing the problem of solving place value by using bridging through ten, she assisted him. Teacher 1 took his exercise book and told him to see and follow all procedures which teacher was doing in his exercise book. Teacher 1 drew three parts on the paper and named each part. Teacher 1 solved the question by using drawings while at the same time this pupil to used his sticks to count.

Sub-theme analysis: It was observed that, there were only two teachers among the four who helped pupils with low mathematical skills during mathematical lesson. Most of them said that they usually help pupils with low mathematical skills after class hours. Scaffolding rarely occurred in mathematical classes due to the large numbers of pupils and short time (40 minutes).

4.6.2 Interaction

Interaction is an action that occurs when two or more persons have an effect on each other. For example, teacher and pupils have effect on each other during the teaching and learning processes. Also, interactions between one pupil and another have an effect on both pupils. The investigator observed interactions through problem solving among pupils with and

without low mathematical skills. In most classes observed by the investigator, interactions between teacher and pupils with low mathematical skills were negative while interaction between teacher and pupils without low mathematical skills were positive during problem solving. For example, all of the teachers investigated liked to select pupils without low mathematical skills to answer or solve the questions. When pupils with low mathematical skills were asked to answer the questions, abusive language was used and at the same time, corporal punishments were administered. For example, Teacher 2 wrote the number 5698 and pointed one pupil to go in front the class and solve this question on the blackboard. The pupil tried to write this number (5698) into words but she failed. Then after writing wrong answer Teacher 2 abused her by saying:” *You always do stupid things, go and sit*”.

Furthermore, another example of negative interaction was when Teacher 3 slashed four pupils who failed to state the mathematical table of number 2, 4 and 5.

In addition to that, positive interactions were also noticed in every observed lesson with all pupils who laughed, made jokes and had fun. During lessons this was visible especially when teachers used games and provided the task to small groups. For Example, Teacher 1 selected five boys and told them to walk like cattle in the class. Pupils laughed and some of them asked the teacher to name those cattle. Then teacher 1 asked pupils: “*How many legs do these cattle have?*” Pupils: “*20 legs*”.

Sub-theme analysis: Generally, there was a negative interaction between teachers and pupils with low mathematical skills while interaction between teachers and pupils without low mathematical skills was positive.

4.6.3 Concluding remarks

Scarce use of different teaching methods and teaching techniques are the factors in prolonging low mathematical skills and mathematical difficulties among the pupils. In order to reduce this problem, the number of pupils in the class should be reduced; enough teaching and learning materials should be provided to both teachers and pupils. Also, teachers should be well motivated and adequate in teaching.

5 DISCUSSION OF THE FINDINGS

Chapter five is comprised of three parts. The first part discusses the major findings in relation to relevant literature and theories cited in chapter two and in connection with some background information on the study. The second part presents a summary and some of the conclusions derived from the findings, while the third part contains some of the recommendations for possible actions by relevant stakeholders and for future research. These recommendations were made in the light of the findings and conclusions of the present study.

5.1 Discussion

The purpose of this study was to investigate the teaching methods used by the teachers when they were instructing pupils who have low mathematical skills in Tanzania with the aim of finding proper intervention strategies to the increase numbers of pupils who will have high achievement in mathematics. As indicated in chapter three, (sec.3.2) four cases were purposefully selected for this study. From each case, one teacher who teaches mathematics in grade three was purposefully selected. These four teachers were chosen to disclose the teaching strategies they use with the different teaching methods and with a focus on pupils with low mathematical skills. The teaching methods could then lead to finding the proper way forward for implementing effective teaching methods in mathematics for pupils with low mathematical skills and those with mathematical difficulties in the inclusive classes. The study was guided by the following main question: How are the teaching conditions and the use of teaching methods for teachers teaching mathematics to pupils with low mathematical skills in the inclusive classrooms? The sub-questions for the study were:

- i. What kind of instructions do teachers use in teaching mathematics to pupils with low mathematical skills?
- ii. What kind of activities do teachers give to pupils with low mathematical skills?
- iii. What kind of teaching materials do teachers use when teaching pupils with low mathematical skills?

As indicated in chapter three, the data was collected by using the interview and observation methods. The instrument used for interviews was the interview guide and the instrument used

for observation was the observation schedule. The presentation and analysis of the results was done in chapter four. In this chapter the study will still discuss the findings; giving conclusions and recommendations based on the findings.

In order to learn the teaching methods teachers used for pupils with low mathematical skills in inclusive classes, the following themes based on the research questions and observation topics have been used. These are: teachers' knowledge of and experiences towards pupils with low mathematical skills, teaching methods, differentiation, use of concrete teaching and learning materials, connectionism and transformation and problem solving. The study investigated the teaching methods which were accompanied by teaching and learning materials, classroom arrangement and organization, teaching instructions, teachers experience and time taken for mathematical lesson.

5.1.1 Teachers' knowledge of and experiences towards low mathematical skills

The findings show that the teachers of mathematics have wide knowledge and experience toward the problem of low mathematical skills among the pupils. During interviews, when posed the question, "*Do you think there are problems of low mathematical skills in your class in inclusive school and why?*" teachers mentioned different causes of low mathematical skills. These causes were: lack of listening skills, shortage of teaching and learning materials, inability to follow instructions, large numbers of pupils, lack of reading and writing skills, poor teaching methods, unsuitable teaching and learning environment, parents' negative attitude towards mathematics and lack of teachers' professional development (capacity building). Some of the causes of low mathematical skills were mentioned by the teachers; some of them were also mentioned by one expert in the field of mathematics in the seminar of Mathematical Association of Tanzania (MAT) (Maige, 2012). The main factors which contribute to pupils having low mathematical skills is that, many teachers are unqualified and they don't know teaching methods and strategies, they prepare poor lesson plan and scheme of work before teaching and have a shortage of important teaching aids (ibid).

In addition to that, from the teachers' knowledge and experience, some of the teachers used few teaching methods (sec 4.1.6) and others did not prepare the lesson plan well before teaching. These two elements are necessary among the elements in the curriculum indicated

in the Curriculum Relational Modal (CRM) by Johnsen (2001). These eight elements are presented in the annex I.

Furthermore, the parents' negative attitude towards mathematics was one of the causes of low mathematical skills among the pupils (sec 4.1.8). The findings show that the negative attitude towards mathematics was also common among the most of the parents. Parents believe that mathematics is hard to understand, and they try to avoid it for their children as far as possible. Mathematics is considered by many individuals to be a difficult subject to learn (Fennema & Sherman, 1976) and this has a direct relation with poor achievement. Children with negative attitudes towards mathematics have performance problems because they develop anxiety (Hembree, 1990). The impact of attitudes on the child is well explained in the Bronfenbrenner Ecological System Theory. For example, in the micro-system which includes family members, peers, school, neighbors, and caregivers within the environment, all these people have a great impact to the child's performance (Bronfenbrenner, 1979). Also, in the macro-system which includes culture, attitudes, morals, belief, and ideologies of the culture, the attitude has the great impact to the learner either positive or negative. In the meso-system, there is a very big connection between a child's teacher and her or his teacher parents. The parent's negative attitudes towards the subject of mathematics lead to a lack of connection between teachers and parents among children with low mathematical skills as well as poor cooperation between teachers and parents. Due to the negative attitudes from the parents and other family members, children develop a fear of mathematics.

Furthermore, Reisman (1972) argues that, children may have heard parents talk about the difficulty in mathematics, through this experience a child start develop negative or unpleasant situation towards mathematics. Therefore, parents' interests and attitude towards mathematics should be positive in order to help their children. Also, Bronfenbrenner Ecological System Theory emphasizes the importance of the relationship between the belief and culture of the family members and their children in order to raise child's development (Henderson, 1996). This is supported by (Westwood, 2004) who argues that, the increasing interest in the impact of cultural influence and different teaching methods may increase achievement for the most of pupils.

Moreover, large numbers of pupils, lack of reading and writing skills, inability to follow instructions, and unsuitable teaching and learning environment caused teachers to fail in assisting every pupil with low mathematical skills during the mathematical lesson. The teacher's assistance of the pupil who fails to perform the task is very important in teaching and learning. This is well supported in the Vygotsky Cognitive Development Theory which insists the parents or other adults in a child's world to provide assistance or guidance to the children while they are learning new information and developing more complex thinking abilities. If the pupil is not able to solve a certain mathematical question, even with support from the teacher, shall be helped, letting him or her do simple questions, as that question is becoming beyond his ZPD. From Vygotsky's idea (1978) of Zone of Proximal Development (ZPD), Brunner's idea (1990) of scaffolding, and Rogoff's ideas (2003) of apprenticeship, guided participation should be provided to the pupils with low mathematical skills. The number of pupils with low mathematical skills is increasing daily due to the lack of enough scaffolding, guidance, apprenticeship and help from their teachers.

Last but not least, despite the fact that the teachers had enough knowledge and experience towards the problem of low mathematical skills among pupils, no action has been taken. The large numbers of pupils in the class seemed to be the greatest reason of all reasons that have been explained through interviews and observation. This is indicated earlier in chapter four on the table 1 as well as in section 4.1.4. Findings show that some of the teaching methods such as group discussion and games were not used due the unsuitable teaching and learning environment (See sec 4.1.6, 4.1.7) and the large number of pupils (See sec 4.1.4). The investigator observed that the class size, arrangement and organization were not favoring some of the teaching methods and the number of the pupils in the classroom. Many studies indicate that reduced class sizes leads to improved student achievement (Wells and Claxton (2002). The large number of pupils in the class caused the teachers fail to use the different teaching methods as well as to achieve the education goal and intention in mathematics. This situation leads the increase of the problem of low mathematical skills among the pupils.

Therefore, to achieve the goal of reducing the problem of low mathematical skills among the pupils and to increase the numbers of pupils who will have high achievement in mathematics and love mathematics subject, reducing class size can be one of the ways to solve this problem.

5.1.2 Teaching methods

The findings show that teachers used many different teaching methods. Through observation and interviews on the question of: *“Please tell me what kind of teaching methods do you normally use in order to improve performance of pupils with low mathematical skills?”*, Teachers mentioned different teaching methods. These methods were: pupil participation, games, demonstration, problems and puzzles, oral and written testing, group discussion, questions and answers, and lecture.

Findings show that the teaching methods which were used most by the teachers were lecture, questions and answers and pupil participation (See sec 4.2). The teachers used few teaching methods for pupils with low mathematical skills. Studies have shown that pupils who exhibit learning difficulties may not be intellectually impaired; rather their learning problems may be the result of an inadequate design of instruction in curricular materials (Osaki, 2007). In line with this, Chinn (2004) argues that instruction that does not differentiate between the ranges of learners in groups can cause mathematical difficulties for most of the learners. This also is supported by Donlan (1998) who argues that failure in using teaching methods for making arithmetic meaningful is the one of the causes of children lacking an understanding of arithmetic. The investigator expected to find the different and appropriate teaching methods for pupils with low mathematical skills such as group discussion, demonstration, games, storytelling, question and answers. Carol et al., (1983) concludes by saying that good instruction is well – balanced instruction. The things that we teach must include concepts, skills and applications. To teach these things effectively teachers need to use a combination of developmental activities, practice activities and application activities (ibid). Generally, all teaching methods could be applied by the teachers, but teachers failed to apply them because of the large number of pupils in the classrooms.

In addition to that, findings show that the mathematical lessons lasted for 40 minutes. This was not enough time when compared to number of the pupils with low mathematical skills in the classrooms and the content of the mathematics curriculum. The teachers failed to accommodate every pupil with low mathematical skills due to the shortage of time. Studies have shown that one of the main causes of learning difficulties in mathematics is the teaching that does not accommodate students’ individual needs and differences (Ginsburg, 1989). Also, the pedagogical factors can be associated with poor learning in mathematics

(Westwood, 2003). These pedagogical factors are: Inappropriate instructional methods, insufficient total time devoted to teaching and learning, demonstration that are too brief or unclear, insufficient guided participation, too little corrective feedback, and abstract symbols introduced too early in the absence of concrete materials or real life examples (ibid).

Findings also revealed that pupils with low mathematical skills were not helped well during the mathematical lesson. The reason behind was the large number of pupils in the class in which teachers failed to accommodate all pupils with low mathematical skills. The role of the teachers was more instructor than facilitator to the pupils with low mathematical skills. Constructivism Theory puts emphasis on the importance and role of the teacher in mathematics class changing from instructor to facilitator of children's own explorations and discoveries. The teacher should become one of many resources that the student may learn from, not the primary source of information (Hanley, 1994). Realistic instruction conforms to the learners' informal knowledge, and the role of the teacher should change from directing to guiding (Milo, 2003). In line with Constructivism theory, Vygotsky's Cognitive Development and the idea of ZDP insists upon giving assistance and help to the learner. Scaffolding (Brunner, 1990), guided participation and apprenticeship (Rogoff, 2003) all emphasize the concept of help given by the teacher to the failed child.

Moreover, findings show that most of the teachers did not often use some of the teaching methods which allow for interaction among the pupils. The investigator expected to find that teachers could use different and appropriate teaching methods which allow interaction such as group discussion, demonstration, games, storytelling, question and answers. Using teaching methods which allow interaction among pupils is very important for pupils with low mathematical skills. Interaction is also emphasized by constructivist practices; drawing on some principles given by Vygotsky (1978), Bruner (1966) and Rogoff (2003). The constructivist argues that, in order for a child to understand mathematics well, he or she should interact with fellow peers (ibid). Therefore, the constructivism classroom, which allows interaction, should pose some features such as teachers having a dialogue with pupils, and help the pupils to construct their own knowledge and pupils should work primarily in groups and collaborate (Hanley, 1994). Each child is born into a cultural historical setting and develops in interaction with its surroundings (Vygotsky, 1978). In line with this, the Bronfenbrenner Ecological System Theory focuses on quality and context of the child's

environment. In the micro-system which includes family members, peers, school, neighbors, and caregivers within the environment, the interaction between the child and environment may cause the child's physical and cognitive structure grow and mature. A child is interacting and constructs knowledge within the society and thus is learning and developing his or her mental and psychological functions (Bronfenbrenner, 1979). Therefore, interaction between pupils and between pupils and pupil and teacher can motivate and enhance learning for pupils with low mathematical skills.

Although Ginsburg (1989) suggests that, the most effective strategy for dealing with learning problems is to improve the quality of instruction. From Ginsburg's argumentation, I agree with him in one hand to apply quality of instruction for the small number of pupils such as 10 to 15. On the hand, I disagree with him If the number of pupils is very large (Sec 4.1.4), the quality of instruction cannot take place or applicable.

5.1.3 Differentiation

Findings revealed that teachers were using different teaching techniques when teaching pupils with low mathematical skills (Sec 4.3). This was revealed through observation and interview to the question of, *"Can you describe how you use different teaching techniques to meet the needs of pupils with low mathematical skills in and out the classroom?"* Teachers mentioned different techniques such as provision of more examples, manipulation and representation of concrete objects, guided participation, use of the small group, error correction and corrective feedback and peer tutoring. Most of the teachers liked to use some of techniques such as manipulation and representation, error correction and corrective feedback, and provision of more examples. Although teachers used different teaching strategies and techniques, they didn't consider every learner's needs. Findings show that teachers did not consider the individual needs due to the large number of pupils. This led the guided participation and the use of the small group to be done rarely while peer tutoring was not done. Consideration of the individual need in teaching is very important since the Vygotsky Cognitive Development theory emphasizes that every individual is unique. Due to this circumstance teacher should identify each individual's social uniqueness in order to accommodate every learner and meet their needs. Tomlinson (1995) argues that differentiated instruction is a necessary component in inclusion teaching as it accommodates all students regardless of their learning abilities. Other studies show that differentiation helps the teachers to meet the diversity of pupils'

educational needs by applying a variety of instructions (Ivory 2007; Norwich 1994; Tomlinson 1995; Westwood 2004). There is a need for differentiating or adapting mathematics instruction to respond to student's needs (Gersten, Jordan, & Flojo, 2005) so that students with low mathematical skills can benefit from standards- based mathematics instruction.

Although teachers used different teaching techniques and strategies, some of the scholars have also mentioned some of the teaching techniques and strategies which teachers should use for learners with learning difficulties, including pupils with low mathematical skills. Kirk et al., (2011) mentions some of these teaching strategies such as scaffolding, reciprocal teaching, cooperative learning, motivation and self-determination. Therefore, the large numbers of pupils affected the teacher's ability to use different and appropriate techniques for pupils with low mathematical skills, such as guided participation, peer tutoring, problem solving based learning, and other techniques.

5.1.4 Use of concrete materials

Findings show that teachers used a variety of teaching and learning materials for pupils with low mathematical skills (Sec 4.4). Answers to the question, "*What kind of teaching materials do teachers use in teaching pupils with low mathematical skills?*" Teaching materials such as bananas, notes and coins, sticks and bottle tops, bottles, string, rulers and clay soil were used by all the interviewees when teaching mathematics. Underhill et al., (1980) describes three types of meaningful mathematics learning experiences: concrete, semi-concrete and abstract. To enhance meaningful learning of basic computational skills, these experiences aim at the duality of process relationships between real- world experiences and the symbol system involved in computations (ibid). Though teachers faced some challenges relating to teaching and learning materials, for example shortage of books, flip charts and other concrete objects, they tried to overcome this challenge by utilizing the materials within their environments. Hands on learning is more powerful way of learning than dry abstract instruction since the young pupils need to touch and have real objects to work with as they begin to master the early formalities of mathematics (Hannell, 2013).

The constructivism theory also emphasizes the importance of using concrete objects in teaching and learning mathematics. Constructivists argue that knowledge might not only be

connected to problem solving with concrete objects, but might be applied on semi-concrete, semi-symbolic and finally establish on the reflective level with the use of abstract symbols (Underhill et al., 1980). Pictures and drawings can help to give meaning to the content of the mathematical task on the level that approaches the symbolic level (Hughes, 1986). Underhill et al., (1980) support the principle that teaching moves on a continuum from the concrete to the abstract level. Also, the constructivist classroom materials include primary sources of materials where learning is interactive, and teachers should build on what the pupils already knows (ibid). By using concrete materials pupils with low mathematical skills could learn the mathematical concepts easily.

5.1.5 Connectionism and transformation

Findings show that connectionism and transformation were done by the teachers during mathematical lesson (Sec 4.5). This was revealed through observation and interview in the question of, “*Can you describe how you transform a concrete object into the abstract meaning to the pupils with low mathematical skills?*” Teachers taught mathematics by connecting home environment by using pupils’ experience and concrete objects. Teachers integrated different issues in mathematical concepts by using daily life situations as examples. In a Tanzanian context, children learn simple arithmetic skills by counting animals like goats, cattle, pigs, chickens, ducks and other birds. They also count tins and sacks of crops such as maize, beans, wheat, sweet potatoes and other crops. Children count fruits like bananas, oranges, avocado, pears, papaws, and passions to mention few. This working knowledge is what children take with them to school and teachers should build from. Most children learn a vast amount of knowledge and understanding well some number sense before they start school (Hughes, 1986; Hannell, 2013). The use of real life experiences that are already familiar to pupils, pupils connect with what is being taught (ibid). Mathematics is meaningful when the learner can think with mental imagery of objects, drawings and personal experiences (Carol et al., 1983). In line with this, Alsopp et al., (2007) argues that there are many different ways to build meaningful student connections and provide linkage. These ways are: link the concept to be taught to students’ previous knowledge and experience, and identify what students will learn and provide students a meaning for learning the skill (ibid). Using real life experiences that are already familiar to the children helps them to connect what is being taught (Hannell, 2013). The prior experience and environment of the learner have great contribution to understanding in mathematics.

The Constructivism Theory promotes active learning through doing and recognition of one's experience. The constructivist believes that people must build their knowledge on the basis of their experiences and that no other alternative exists. They build up knowledge and concepts, (Glaserfeld, 1996). Teachers taught by engaging pupils in experiences that challenge previous conceptions of their existing knowledge by using pupil's daily life situations. For example, the case of experience was considered from the activities which were familiar to the pupils such as counting cattle and bananas which facilitated understanding in the pupils with low mathematical skills, and taking it in a natural flow as acculturated subject. Booker et al., (1997) argue that, if the mathematics to be introduced cannot be related to the child's experiences, it is simply will not make sense and the child will be reduced to manipulating meaningless symbols. In line with this, Allsopp et al., (2007) argue that helping students make connectionism between ideas can help them to gain more lasting understanding of mathematics. Therefore, it is very important to use pupils experience and home environment in teaching and learning mathematics.

5.1.6 Problem solving

Findings show that teachers provided many tasks to perform to pupils with low mathematical skills (Sec 4.6). This was revealed through observation and interview on the question of, *"What kind of activities do you give pupils with low mathematical skills?"* The kind of activities which involved problem solving was: assignments, oral and written questions, monthly tests, semester exams and annual exams. Pupils with low mathematical skills were given different tasks to perform. Allsopp et al., (2007) argue that problem solving should be a regular part of classroom instruction to help students become critical thinkers and independent learners. In line with this, NCTM (2000) states that; *"without the ability to solve problems, the usefulness and power of mathematical ideas, knowledge, and skills are limited"* (P.182).

Also, findings show that some of the teachers emphasized that pupils use concrete objects such as seeds and sticks when solving mathematical questions. Donlan (1998) emphasized the specific artifacts and procedures of calculation and measurement have been organized dependent on specific practices, and these artifacts and procedures have been utilized for organizing specific courses of actions in these practices.

Findings show that in the task of problem solving, some assistance was provided to the pupils who failed to perform the tasks alone (See sec 4.6.1). From observation and interview through the question of, “*May you briefly tell me how you differentiate the independent level of mastery to pupils with low mathematical skills*”? Teachers answered that they know the independent level of mastery to each pupils through questions and test. When the pupils with low mathematical skills were solving some questions; teachers assisted them when they failed. This is well emphasized in the Vygotsky Cognitive Development Theory through the idea of Zone of Proximal Development. When the teacher realized that a certain pupil has failed to do the task alone, the teacher went to assist her or him. In line with ZPD of Vygotsky, guided participation and apprenticeship as the two ideas of Rogoff (2003) were provided by the teachers. Teachers guided some of pupils with low mathematical skills during problem solving. Some of the teachers helped the pupils with low mathematical skills when they failed. Generally, guidance rarely occurred due to the large numbers of pupils in the classroom.

Findings show that through problem solving, interactions between pupils with low mathematical skills and teachers occurred (Sec 4.6.2). When the pupils with low mathematical skills were solving questions the interactions were highly negative. The positive interactions occurred with pupils who had no problems of low mathematical skills. Teachers liked to select the pupils who had no low mathematical skills to answer questions and ignore those with low mathematical skills. Studies show that interactions should be positive and teachers should not ignore those learners with difficulties (Tomlison, 1995). Vygotsky’s Cognitive Development theory insists that learning is taking place through interaction and the teacher’s role should be interactive and rooted in negotiation (Vygotsky, 1978). In line with this, Bronfernbrenner Ecological System Theory emphasizes the importance of interaction between the child and environment by using the four systems. Generally, negative interactions caused pupils with low mathematical skills to fear their teachers and hate the subject of mathematics.

5.2 Conclusion

During data collection, the teachers could clearly use different teaching methods to the pupils with low mathematical skills but this happened contrary to the expectation of the investigator.

In the process of data presentation, analysis and discussion, some particular issues seemed central and emerged on occasion. There are two main issues that emerged in the findings as main problems which caused low mathematical skills among the pupils.

One of the main issues that emerged was the large numbers of pupils in the classroom. This is indicated in section 4.1.4. From my experience, teachers teaching in the lower grades where the number of students in a class is large agree that the classroom atmosphere is not good. Pupils cannot receive more individualized attention, and teachers have no flexibility to use different instructional approaches and strategies. Therefore, if class sizes were reduced and organized well, it would be easy for teachers to use different teaching methods and strategies so as to accommodate all learners in the class. It is important to note that the large number of pupils in the class causes teachers not to accommodate every learner's needs hence guidance, assistance, apprenticeship and scaffolding could not take place effectively. As stated earlier, reducing class size is one strategy of reducing the number of pupils with low mathematical skills as well as those with mathematical difficulties.

The second main issue is the shortage of teaching and learning materials such as text books. This can be seen in section 4.1.2. On one hand, the above sources may open a room for a wide possibility about sources and theoretical perspective of study. On the other hand I can see a lack of specific materials to the exact topic and context of my study. For example, though Kitta (2004) is researching about Tanzanian context, his focus is on the secondary school, leaving out my primary school focus of study. At the same time, the specific context of Arusha District Council lacks any written material about this particular low mathematical skills problem which as a result makes my research a necessary inquiry to explore and document the context.

Another issue that emerged was the issue of the use of only a few teaching methods. This can be seen in section 4.2 where most of the teachers (respondents) used some of the teaching methods such as lecture, pupil participation, question and answers and oral and written testing. Some of the teaching methods which are appropriate and relevant for pupils with low mathematical skills were rarely used by few teachers such as group discussion and games. Use of songs and storytelling was not used at all. Studies show that prospective elementary teachers would struggle to represent some mathematical problems like fractions with appropriate story problems (Berk & Hiebert (2009)). Also, constructionism theory is

emphasizing that mathematical teachers should have both content and pedagogical knowledge (Halai, 1998) in order to use different teaching methods to pupils with different abilities.

The aspect of inattention to pupils with low mathematical skills seemed to emerge in sections 4.1.1 and 4.1.3. Interviewees explained that the problem of low mathematical skills among the pupils is caused by pupils themselves not listening to their teachers. Pupils are not following instructions and are not paying attention in, teachers said. The lack of listening skills lead to some of the pupils also lacking reading and writing skills (sec 4.1. 5). Despite the fact that teachers have enough knowledge of and experience with the problem of low mathematical skills, no action has been taken. The investigator expected that teachers could give different tasks which can make pupils with low mathematical skills to pay attention in listening such as reading stories of mathematics. In line with this, Tomlinson (1995) stressed that differentiated instruction is not individualized instruction, it is not losing control of student behavior and just another way to provide homogeneous grouping, it is not giving the same exercises or tasks to most pupils and different to pupils who showed difficulties.

Another aspect which emerged and was repeated was the aspect of problem solving. This can be seen in sections 4.2, 4.4 and 4.6. In section 4.2 the teachers used some different teaching methods and gave the pupils some task or problem to solve. In the lecture method no problem solving took place. Section 4.4 shows various teaching aids (concrete objects) which teachers used with the pupils with low mathematical skills. Most of the teachers, after using the concrete objects, provided some tasks for the pupils to perform. In section 4.6, different tasks were given to the pupils with low mathematical skills. Problem solving is very important in learning mathematics. Problem solving is one among of the main ideas provided by Hughes (1986) that are important in mathematics. In line with this, The National Council of Teachers of Mathematics (NCTM) 1980's put greater emphasis on problem solving in mathematics at all levels. Despite the fact that the teachers provided many mathematical problems to solve but the problem of low mathematical skills continued to exist. Teachers should continually use and encourage the use of a variety of approaches to problem solving (Bley, 1995).

In relation to Vygotsky's Cognitive Development Theory in the ZDP, chapter two observes that it is better for teachers and other experienced persons or adult to know what a child can do alone and the capable person to come in to help when a child cannot finish a particular task

on his own. This help which Vygotsky (1978) and Brunner (1990) refers to as scaffolding, Rogoff (2003) refers to as guided participation and apprenticeship enables the helper to give assistance and make a child familiar with the problem.

5.3 Comment to the validity of the instrument

To validate the findings, the validity of the instrument was extremely influential in this study as stated earlier on in chapter three (methodology). Since external validity can not be applied to qualitative research, the study suggested thinking about the “transferability” of the results obtained from the four primary schools of this study. All results from the four cases were related as asked for in the interview guide and observation schedule. As a result, the instruments used for the study and the findings seem to be valid because the observation and interviews from the four cases gave similar information, which also indicated the validity of the instruments. This can be seen when results are compared to other studies which have indicated that the main cause of the problem of low mathematical skills among the pupils is inadequate teaching methods. To overcome this existing problem, teachers provided six suggestions like:

- i. The government should provide enough teaching and learning materials such as books, teaching resources (teaching aids), and pupils learning books.
- ii. The Tanzanian curriculum should be flexible and not rigid.
- iii. The government should propose one book which will be used to teach mathematics from grade one up to seven.
- iv. Seminars and workshops should be provided to mathematical teachers in order to acquire new skills, knowledge and competence in mathematical subject.
- v. The number of pupils should be reduced so as to manage all pupils and meet their learning needs.
- vi. There should be cooperation between teachers and parents.

In addition to that, Vygotsky’s scaffolding instructions and his concept of the Zone of Proximal Development in his social cultural theory, principles of Constructivism Theory and , Bronfernbrenner Ecological System Theory which emphasize that for effective teaching and learning of a given learner there is a need for identifying what that particular learner knows

and can do and then build up from there with the help of experienced or capable persons while following the principles of the two theories and findings. In line with scaffolding, the three theories also insist upon positive interactions between teachers and pupils with learning difficulties, including pupils with low mathematical skills, mathematical difficulties and dyscalculia. The study therefore has thought of the transferability or applicability of the findings to other settings rather than generalization of the findings. This has led to the development of the recommendations below.

5.4 Recommendations

- i. Teachers should use more participatory teaching methods such as group discussion, question and answers, games, story telling, songs, and demonstration.
- ii. Mathematics should be taught practically. Teachers should provide abundant opportunities for practice and application and response by the children (e.g answering the teachers' questions and staying on task).
- iii. Teachers should provide positive interactions, love and care for the pupils with low mathematical skills by encouraging them to do more mathematical tasks. Teachers should provide simple questions while helping them slowly to solve difficult questions.
- iv. Teachers should use more teaching aids (concrete objects) when teaching mathematics especially to the pupils with low mathematical skills and other with mathematical difficulties.
- v. Class sizes should be reduced so as to help teachers to accommodate all learners and their differences. This can help scaffolding, guided participation, apprenticeship and positive interactions to take place especially for pupils with low mathematical skills.
- vi. The government and the Ministry of Education and Vocational Training (MoEVT) should capacitate teachers by giving them training, seminars and workshop so as to motivate them and give them new knowledge, skills and abilities in teaching mathematics subject.

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Appendices

Appendix A: Letter from the University of Oslo

UiO : Faculty of Educational Sciences
University of Oslo

MICHAEL, Tulia Deo Bamira
Olav M Troviks vei 28 HO 104
0864 OSLO

Date: 15 June 2012
Your ref.:
Our ref.: int./2012 JBH/db

TO WHOM IT MAY CONCERN:

This is to certify that, **MICHAEL, Tulia Deo Bamira**, date of birth 03.11.1983, is a full-time student pursuing a course of study at the Department of Special Needs Education at the University of Oslo, Norway, leading to the degree of Master of Philosophy in Special Needs Education (M. Phil. SNE).

This is a continuous two-year programme run on the "sandwich" principle, which involves periods of study and field work/research in both Norway and the home country. The student has successfully completed both the first and second semester of the initial study period in Norway and will be working on the collection of data and the writing of a thesis during the autumn semester 2012. This involves a period of field work in Tanzania. The student will return to Norway at the beginning of January 2013 and the period of study will be completed at the end of May 2013 in Norway.

The main responsibility for supervising the research, developmental work and thesis remains with the Department of Special Needs Education, University of Oslo, Norway. However, we would kindly request that the relevant authorities give the student the access required to the schools and educational establishments necessary in order to undertake field work and research. We would also be most grateful for any assistance that is afforded to the student which enables her to carry out this work, particularly the use of facilities such as access to telephone, fax, e-mail, computer services and libraries at the various educational establishments.

Yours sincerely



Associate Professor Jorun Buli-Holmberg
Academic Head of International Master's Programme
Department of Special Needs Education

INSTITUTT FOR SPESIALPEDAGOGIKK
UNIVERSITETET I OSLO
P.B. 1140 BLINDERN
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The Department of Special Needs
Education (DSNE)
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Sem Sælands vei 7, 0371 Oslo

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Telefax: (+47) 22 85 80 21
postmottak@uv.uio.no
www.uv.uio.no/isp/
Org. no.: 971 035 854

Appendix B: Permission Letter from the Ministry Of Education and Vocational Training

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION AND VOCATIONAL TRAINING

Cable: "ELIMU" DAR ES SALAAM
Telex: 41742 Elimu Tz.
Telephone: 2121287, 2110146
Fax: 2127763
In reply please quote:



POST OFFICE BOX 9121
DAR ES SALAAM

Ref. ED/EP/ERC/VOL. V/100

Date: Monday, July 23, 2012

The Regional Administrative Secretary -Arusha
(ATT. Regional Education Officer)

RE: RESEARCH CLEARANCE FOR MS. TULIA DEO BAMIRA MICHAEL

The captioned matter above refers to.

The mentioned is bonafide student of University of Oslo-Norway who is conducting research on the topic titled "**Teaching Methods for Pupils with Mathematical Difficulties in Primary School: Case Study of Teaching Mathematics in Primary School-Tanzania**" as part of her course programme for the award of Masters of Philosophy in Special Needs Education (M.PHIL.SNE).

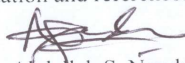
The researcher needs to collect data and necessary information related to the research topic in sampled Primary Schools at Arumeru District Council.

In line with the above information you are being requested to provide the needed assistance that will enable her to complete this study successfully.

The period by which this permission has been granted is from **23rd July, 2012 to 30th December, 2012.**

By copy of this letter, **Ms. Tulia Deo Bamira Michael** is required to submit a copy of the report (or part of it) to the *Permanent Secretary, Ministry of Education and Vocational Training* for documentation and reference.

Yours truly,



Abdullah S. Ngodu
For Permanent Secretary

CC: **Ms. Tulia Deo Bamira Michael**, University of Oslo, P.O. BOX 28HO104,
0864-Oslo, Norway

Appendix C: Permission Letter from the Regional Education Office

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

MKOA WA ARUSHA
Anwani ya Simu: "REGCOM"
Simu Na. 254-5608/2545870/2545872
Fax Na. 254-5239/254-4386
E-Mail: rasarusha@gmail.com
E-Mail: rasarusha@yahoo.com



OFISI YA MKUU WA MKOA,
S.L.P. 3050,
ARUSHA.

Unapojibu Tafadhali taja:

Kumb. Na. AR/ED/R.20/3

24/07/2012

Afisa Elimu Wilaya Msingi,
Halmashauri ya Wilaya ya Arusha,
MKOA WA ARUSHA.

YAH: KUMTAMBULISHA KWAKO BI TULIA DEO BAMIRA MICHAEL

Husika na somo hapo juu.

Mtajwa kwenye barua hii ni mwanafunzi wa Chuo Kikuu cha Oslo-Norway. Amerudi nchini kuja kufanya utafiti juu ya **"Teaching Methods for pupils with Mathematical difficulties in Primary School. Case Study of Teaching Mathematics in Primary School – Tanzania.**

Naomba umpe ushirikiano wa karibu ili aweze kukamilisha utafiti wake ambao ni sehemu ya masomo anayosoma.

Natanguliza shukrani.

K. K. Kabeja

**Kny:- AFISA ELIMU MKOA
ARUSHA**

**M.Y. AFISA ELIMU WA MKOA
ARUSHA**

Appendix D: Permission Letter from the District Education Office

HALMASHAURI YA WILAYA YA ARUSHA

(Barua zote za kiofisi zitumwe kwa Mkurugenzi Mtendaji)

Mkoa wa Arusha
Telegram: Arusha
Simu: (+255) 027 250-2737
Faksi: (+255) 027 250-3701



UKUMBI WA HALMASHAURI
IDARA YA ELIMU
S.L.P 2330
ARUSHA

Kumb. Na.MM/AR/E10

25/07/2012

Mwalimu Mkuu,
SHULE YA MSINGI ENYUATA


Yah: **KUMTAMBULISHA KWAKO BI TULIA DEO BAMIRA MICHAEL**

Tafadhali husika na somo tajwa hapo juu

Mtajwa kwenye barua hii ni Mwanafunzi wa Chuo Kikuu cha Oslo-Norway.
Amerudi Nchini kuja kufanya utafiti juu ya "Teaching Medhods for Pupils with
Mathematical difficulties in Primary School. Case Study of Teaching
Mathematics in Primary School - Tanzania.

Naomba umpe ushirikiano wa karibu ili aweze kukamilisha utafiti wake ambao
ni sehemu ya masomo anayosoma.

Natanguliza shukrani.


A. B. Dellow,
K.n.y Mkurugenzi Mtendaji,
HALMASHAURI YA WILAYA YA ARUSHA.

Nakala: Mkurugenzi Mtendaji,
HALMASHAURI YA ARUSHA. - Aione kwenye jalada

Appendix E: Introduction Letter to the Teachers / Respondents

LETTER OF INTRODUCTION

To: The Head Teacher /Class Teacher

Dear Sir/Madam,

Re: Permission to carry out Research in your School/Class

The heading above is very much concerned. My name Tulia Deo Bamira Michael, a student of the University of Oslo, Norway doing a master of Philosophy in Special Needs Education. I intend to research on the topic: **TEACHING METHODS FOR PUPILS WITH LOW MATHEMATICAL SKILLS IN PRIMARY SCHOOL:** Case study of teaching mathematics in primary school, Tanzania. I have identified your school for the purpose of this study for one reason that your school is inclusive school. Therefore, I strongly feel that your participation in this study will be very valuable help because together we will find proper interventions for reducing the problem of low mathematical skills among the pupils in your school.

In addition to that, I will particularly be interested in doing the two main things with you:

- a) To discuss with you formally about the teaching strategies do you use for pupils with low mathematical skills during mathematical lesson
- b) To come into your class to observe the teaching methods which you use for pupils with low mathematical skills. This is purely for research purposes and has nothing to do with either the school administration or your personal professional records.

The result of this study will be two folds. One part will initially be of use on the requirement of my study in Oslo University, but this will be used later on and be part of helping to build up more cost effective, flexible, and yet manageable teaching strategies that the majority of mathematics teachers could use to help the pupils with low mathematical skills in inclusive classes.

Also, the proceedings of our discussion will be held with maximum privacy, anonymity, confidentiality, professional code of conduct and above all, with the informed consent. As a matter of fact, a right to privacy, sensitivity of information and the spirit of volunteer will highly be respected. There wish to pull out of the discussion once started, please feel free to do so. This won't interrupt on your professional work as a teacher.

I would like to point out that after this study is finalized, you would be welcome to have a copy of it without any opposition. Also, I will appreciate if you gave this request your owing consideration by sending back your personal opinions on participation by filling in a consent form.

I look forward to your response.

Yours faithfully,

Tulia Deo Bamira Michael

Appendix F: Observation Guide Form

Name-----

Subject-----

Grade-----

Date-----

A. Classroom arrangement and organization

1. Looking at the classroom arrangement and organization to pupils with low mathematical skills

2. Classroom interaction

2. Observing the interaction between teacher and pupils with low mathematical skills

C. Teaching methods

3. Identified methods which teachers use to all pupils with and without low mathematical skills

D. Teaching strategies

4. Identified techniques which teachers use to all pupils with and without low mathematical skills

E. Teaching and learning materials

5. The use and effectiveness of teaching aids

- 4 The way pupils with low mathematical skills use learning materials

E. Time

- 5 The time pupil with low mathematical skills spend on task

F. Teachers knowledge and experience

- 6 Identifying teacher's knowledge and ability in instructing pupils with low mathematical skills

G. Lesson plan and scheme of work

- 7 Observing the way teachers use lesson plan and scheme of work

Appendix G: Semi-Structured Interview Guide

Name-----

Subject-----

Grade-----

Date-----

A. General question

1. Do you think there are problems of low mathematical skills in your class in inclusive school and why?

B. Teaching methods

2. Please tell me what kind of instructions do you use in teaching mathematics to pupils with low mathematical skills?

C. Teaching strategies

3. Can you describe how do you use different teaching techniques to meet the needs of pupils with low mathematical skills in and out the classroom?

D. Assignment

- 8 (a) What kind of activities do you give to pupils with low mathematical skills?
(b) May you briefly tell how do you differentiate the independent level of mastery to pupils with low mathematical skills?

F. Teaching materials

- 9 (a) What kind of teaching materials do you use in teaching pupils with low mathematical skills?
(b). Do you have any of the teaching aids, especially extra, that you use to facilitate pupils with low mathematical skills?
(c) How do you use teaching aids with your lesson plan?
(d) How do you incorporate manipulative and hands on activities for pupils with low mathematical skills?

G. Daily life situation

6. Can you describe how you transform a concrete object into the abstract meaning to the pupils with low mathematical skills?

I. Suggestions

7. What are your general suggestions that you think can improve the teaching of mathematics?

Appendix H: Informed Consent Form

I have received oral and written information about the study of teaching methods for primary school pupils with low mathematical skills and

.....would like to participate.

Full name of the participant teacher.....

Signature, date:

Mobile phone number.....

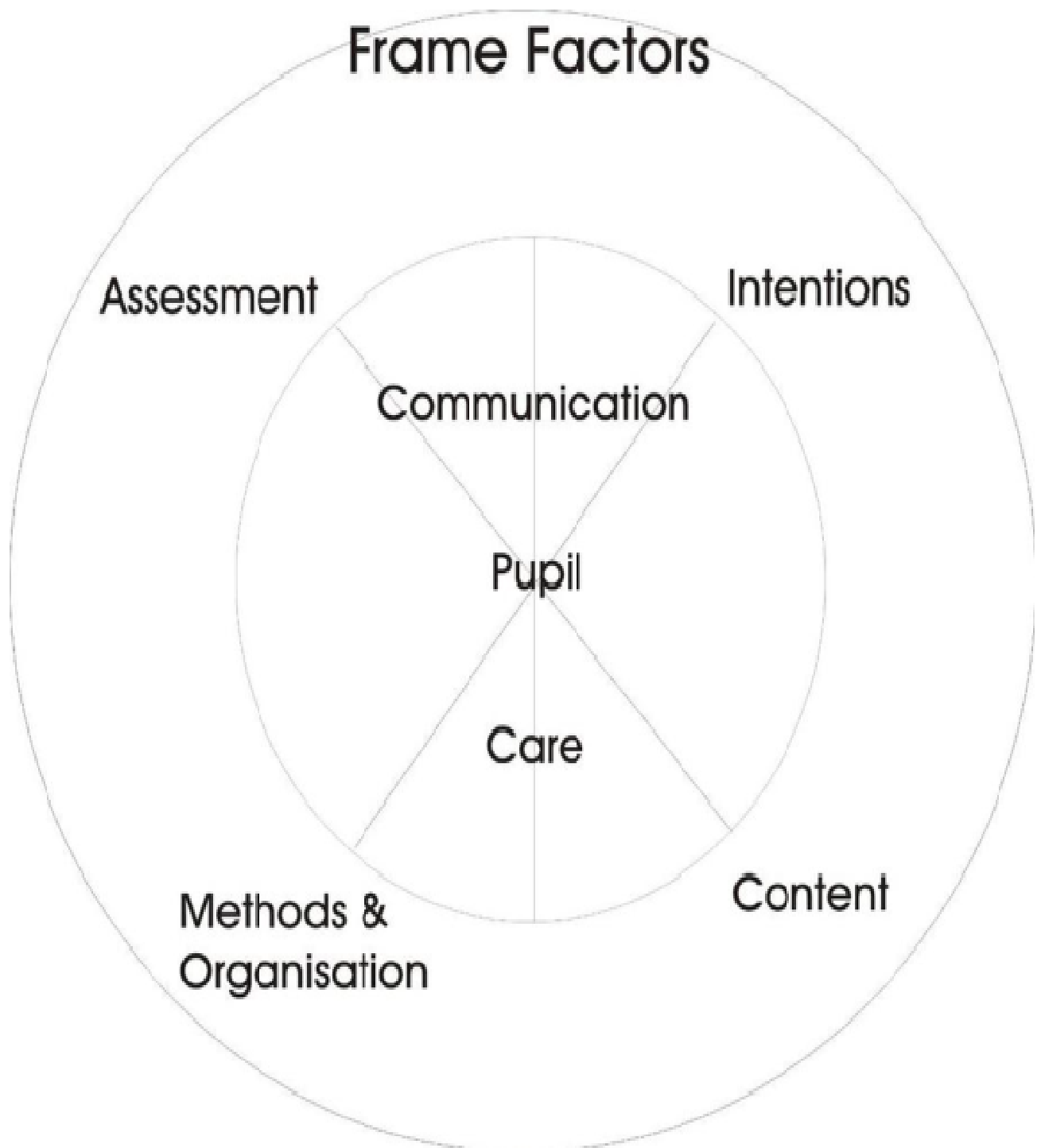
.....Do not want to participate.

Name.....

Signature, date:

Appendix I: Curriculum Relation Model

Adapted from Jonsen (2001)



Appendix J: Map of Tanzania

Adapted from https://www.cia.gov/library/publications/the-world-factbook/maps/maptemplate_tz.html.

